PB80-223050

Treatability Manual. Volume I
Treatability Data

(U.S.) Environmental Protection Agency
Washington, DC

Jul 80

U.S. Department of Commerce
National Technical Information Service
NTIS

BIBLIOGRAPHIC INFORMATION

PB80-223050

Treatability Manual. Volume I: Treatability Data.

Jul 80

PERFORMER: Environmental Protection Agency, Washington, DC.
Office of Research and Development.
EPA-600/8-80-042A

See also Volume 2, PB80-223068. Also available in set of 5 reports PC E99, PB80-223043.

Volume I is a comendium of treatability data for specific compounds. Volume I of the Treatability Manual supplies data on specific compounds. It is intended to provide facile reference to physical data on the pollutants, their occurrence patterns, and methods of treatment and/or removal.

KEYWORDS: *Waste water, *Water pollution control.

Available from the National Technical Information Service,
Springfield, Va. 22161

PRICE CODE: PC A99/MF A01

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ARSENIC[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	46	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			>28-80	<8.5	III.4.5
Gas flotation with chemical addition (alum, polymer)			56[d]	3.5[d]	III.4.5
Filtration			31->99	28	III.4.6
Sedimentation			68->99	72	III.4.2
Sedimentation with chemical addition (alum, lime)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (lime, polymer)			37-75	10	III.4.3
Sedimentation with chemical addition (Fe^{2+}, lime)			>69->99	<2	III.4.3
Sedimentation with chemical addition (sulfide)			>99[d]	5[d]	III.4.3
Sedimentation with chemical addition ($BaCl_2$)			17->33	<8.5	III.4.3
Sedimentation with chemical addition (alum, polymer)			29[d]	12[d]	III.4.3
Sedimentation with chemical addition (alum)			19->37	32	III.4.3
Sedimentation with chemical addition (lime)			60->99	<16	III.4.3
Ozonation			24-48	23	III.6.14
Activated sludge			>43->96	35	III.5.1
Granular activated carbon adsorption			21->99	11	III.6.1
Reverse osmosis			79->99	7.7	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 108.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 6-1 - 6-17.

3. The Chemical Rubber Company. Handbook of Chemistry and Physics, 48th Edition. Cleveland, Ohio, 1967. p. B-101.

4. Manual of Treatment Techniques for meeting Interim Primary Drinking Water Regulations. EPA-600/8-77-005, U.S. Environmental Protection Agency, Cincinnati, Ohio, May 1977. 73 pp.

Compound: Asbestos

Alternate Names [1]: Chrysotile, Amosite, Amphibole, Crocidolite, Tremolite, Anthophylite

Formula:
Chrysotile - $3MgO \bullet 2SiO_2 \bullet 2H_2O$
Tremolite - $CaMg_3(SiO_3)_4$
Crocidolite - $NO_2O \bullet Fe_2O_3 \bullet 2FeO \bullet 6SiO$

CAS #: 1332-21-4

Physical, Chemical, and Biological Properties

mol. wt.: Varies
m.p., °C: Varies
b.p. (760 torr), °C: Unknown
vapor pressure (25°C), torr: Negligible
solubility in water (25°C), mg/L: Not applicable

Probable Fate [2]

photolysis: Asbestos is not photolyzed under environmental conditions
oxidation: Asbestos is resistant to oxidation
hydrolysis: Asbestos is not hydrolyzed under environmental conditions
volatilization: Negligible from aqueous solutions, may be aerosol under windy conditions
sorption: Does not have an adsorptive affinity for solids normally found in natural water systems
biological processes: No evidence was found regarding bioaccumulation
other reactions/interactions: Asbestos is refractory in the aquatic environment

Precipitation/Coagulation Properties: Not available

INDUSTRIAL OCCURRENCE OF ASBESTOS[a,b]

Industry	Raw wastewater					
	Concentration, 10^6 fibers/L			Loading,[c] 10^6 fibers/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Petroleum refining	NA	34[d]	34[d]	0	3.2	0.20
Ore mining and dressing	4.2×10^6	1.4×10^7	3.8×10^8	0	NA	1.4×10^7
Steam electric power generating (condenser cooling system)	BDL	1.6×10^8	BDL	-[e]	-[e]	-[e]
Steam electric power generating (water treatment)	NA	NA	NA	NA	NA	NA
Nonferrous metals manufacturing	2.2×10^6	1.3×10^{11}	3.1×10^{10}	0	NA	1.6×10^9

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] One sample.

[e] Mean pollutant concentration below detection limit.

INDUSTRIAL OCCURRENCE OF ASBESTOS[a,b]

Industry	Treated wastewater					
	Concentration, 106 fibers/L			Loading,[c] 106 fibers/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Petroleum refining	NA	NA	NA	NA	NA	NA
Nonferrous metals manufacturing	NA	1.3×10^{11}[d]	1.3×10^{11}[d]	0	NA	6.9×10^{12}

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ASBESTOS[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., 10^6 fibers/L	Removal range,[c] %	Average achievable conc., 10^6 fibers/L	
Filtration			90->99	470[f]	III.4.6
Sedimentation			80->99	3,000[f]	III.4.2
Sedimentation with chemical addition (lime, polymer)			>99[d]	8.2[d,f]	III.4.3
Sedimentation with chemical addition ($BaCl_2$)			38-75	140[f]	III.4.3
Sedimentation with chemical addition (lime)			95[d]	6.1[d,f]	III.4.3

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

[f] Measured in 10^6 fibers/L.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 114.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 7-1 - 7-17.

Compound: Beryllium Formula: Be

Alternate Names [1]: Glucinium

CAS #: 7440-41-7

Physical, Chemical, and Biological Properties [2, 3]

at. wt.: 9.012 m.p., °C: 1,280 b.p. (5 mm Hg), °C: 2,970
vapor pressure (25°C), torr: Negligible
solubility in water (30°C), mg/L: BeO, 0.2
common oxidation states: +2

Probable Fate [2]

photolysis: No data found on photolysis of beryllium
oxidation: Not important
hydrolysis: Soluble beryllium salts are hydrolyzed for form insoluble beryllium hydroxides
volatilization: Airborne dusts are the most widely known hazard associated with beryllium
sorption: No data found of adsorption of beryllium
biological processes: Beryllium is only slightly bioaccumulated
other reactions/interactions: No data were found relative to aquatic fate on biotransformation of beryllium or its compounds

Precipitation/Coagulation Properties: Not available

INDUSTRIAL OCCURRENCE OF BERYLLIUM[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	1	57	17	0	0.45	0.064
Textile mills	NA	40	<5[d]	2.1×10^{-5}	0.14	0.0090
Timber products processing	BDL	19	4[e]	0	0.18	0.00034
Petroleum refining	<1	<20	<2[d]	0	0.19	0.012
Paint and ink formulation	BDL	100	10	0	0.00046	1.6×10^{-5}
Auto and other laundries	ND	15	3	2.7×10^{-6}	0.0042	0.00063
Porcelain enameling	1.0	120	20	0.000013	0.0082	0.0016
Ore mining and dressing	<2	<20	<8	0	NA	<0.30
Steam electric power generating (condenser cooling system)	BDL	10	4.2	0.00022	0.0046	0.001
Steam electric power generating (water treatment)	NA	NA	5,000[e]	3×10^{-5}	300	0.75
Steam electric power generating (boiler or steam generator blowdown)	NA	NA	NA	NA	NA	NA
Steam electric power generating (maintenance cleaning)	NA	NA	<10	$<1 \times 10^{-8}$	<0.19	<0.003
Steam electric power generating (ash handling)	BDL	2.5	<1.0	<0.000019	<0.098	<0.022
Steam electric power generating (air pollution control devices)	<2.0	180	91	8.7×10^{-5}	5.2	0.33
Steam electric power generating (drainage)	NA	NA	4.0[e]	3.4×10^{-5}	0.0015	8×10^{-5}
Nonferrous metals manufacturing	ND	310	38	0	NA	2.0
Iron and steel manufacturing	NA	10	7.3	0	NA	1.3

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF BERYLLIUM[a,b]

Industry	Treated wastewater					
	Concentration, mg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	0.001	<0.001	0	2.6×10^{-5}	3.8×10^{-6}
Textile mills	NA	5	<5[d]	$2.1 \times 10^{-}$	0.14	0.009
Timber products processing	BDL	13	BDL	-[e]	-[e]	-[e]
Petroleum refining	<1	<3	<2[d]	0	0.19	0.012
Paint and ink formulation	BDL	20	9	0	0.00041	1.4×10^{-5}
Auto and other laundries	<0.1	<5.0	2.6	2.3×10^{-6}	0.0036	0.00054
Ore mining and dressing	<0.002	<0.002	<0.002	0	NA	7.4×10^{-5}
Foundries	<20	<20	<20	0	0.13	0.054
Iron and steel manufacturing	NA	10	76	0	NA	14
Non ferrous metals manufacturing	ND	170	19	0	NA	1.0

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BERYLLIUM[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gravity oil separation			NA	2^d	III.4.1
Filtration			29-71	1.6	III.4.6
Sedimentation			>87->98	<10	III.4.2
Sedimentation with chemical addition (Fe^{2+}, lime)			>82->89	<0.5	III.4.3
Sedimentation with chemical addition (alum)			$0^{d,e}$	$-^e$	III.4.3
Sedimentation with chemical addition (lime)			38-76	0.85	III.4.3
Aerated lagoons			$>50^d$	$<1^d$	III.5.3
Granular activated carbon adsorption			0^e	$-^e$	III.6.1
Reverse osmosis			>42->85	<2.8	III.6.9

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 225.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 8-1 - 8-7.

3. The Chemical Rubber Company. Handbook of Chemistry and Physics, 48th Edition. Cleveland, Ohio, 1967. p. B-102.

Compound: Cadmium Formula: Cd

Alternate Names [1]: Kadmium (German)

CAS #: 7440-43-9

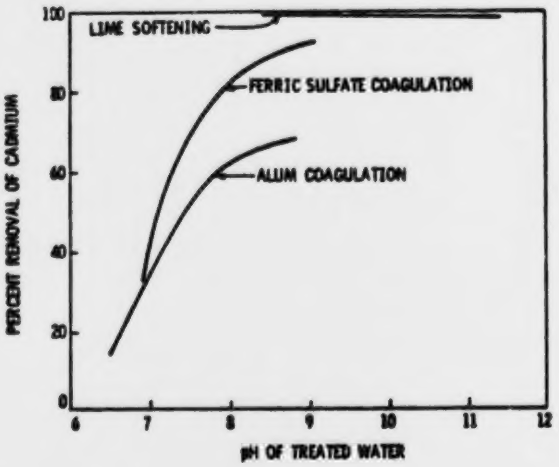
Physical, Chemical, and Biological Properties [2-4]

at. wt.: 112.4 m.p., °C: 321 b.p. (760 torr), °C: 765
vapor pressure (25°C), torr: Negligible
solubility in water, mg/L: $CdCl_2$, 1.40×10^6 at 20°C; CdS, 1.3 at 18°C; $Cd(OH)_2$, 2.6 at 25°C
common oxidation states: +2 (always +2 in water)

Probable Fate [2]

photolysis: It is not an important mechanism in determining fate of cadmium compounds
oxidation: In reducing condition, Cd may precipitate with reduced sulfur to form CdS
hydrolysis: Aqueous solutions of cadmium salts are hydrolyzed to form hydroxide compounds
volatilization: It is not known to form volatile compounds
sorption: Sorption processes are important in determining cadmium transport, partitioning, and potential for remobilization
biological processes: Accumulates in the tissues of aquatic and marine organisms at higher concentration
other reactions/interactions: Organic ligands of biological origin may affect solubility and adsorption

Precipitation/Coagulation Properties [5]



INDUSTRIAL OCCURRENCE OF CADMIUM[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	2	20	14	0	0.37	0.053
Textile mills	NA	46	<5[d]	2.1×10^{-5}	0.14	0.0090
Timber products processing	BDL	10	1[e]	0	0.046	8.6×10^{-5}
Petroleum refining	<1	<220	<20[d]	0	1.9	0.12
Paint and ink formulation	BDL	810	57	0	0.0026	9.1×10^{-5}
Gum and wood chemicals	95	120	110	0.00099	0.83	0.18
Rubber processing	NA	720	190	3.8×10^{-5}	0.16	0.0063
Auto and other laundries	ND	520	24	0.00002	0.034	0.0050
Porcelain enameling	ND	9,600	740	0.0005	0.303	0.059
Pharmaceutical manufacturing	ND	32	2.7	0	0.018	0.0025
Ore mining and dressing	<5	25	<5.7	0	NA	<0.21
Steam electric power generating (condenser cooling systems)	BDL	200	4.0	0.0002	0.004	0.0010
Steam electric power generating (water treatment)	NA	NA	5,000[e]	3×10^{-5}	300	0.75
Steam electric power generating (boiler or steam generator blowdown)	NA	NA	NA	NA	NA	NA
Steam electric power generating (maintenance cleaning)	<1.0	51	6.5	6.5×10^{-5}	0.12	0.002
Steam electric power generating (ash handling)	BDL	10	2	4×10^{-5}	0.20	0.044
Steam electric power generating (air pollution control devices)	4.0	110	57	5×10^{-5}	3.2	0.20
Steam electric power generating (drainage)	NA	NA	10[e]	9×10^{-5}	0.0037	0.0002
Inorganic chemicals manufacturing	NA	300[f]	NA	0	19	3.8
Coil coating	ND	200	22	0.001	0.040	0.011
Foundries	ND	740	140	0	0.94	0.378
Nonferrous metals manufacturing	2.3	80,000	5,400	0	NA	286
Iron and steel manufacturing	NA	1,800	213	0	NA	38

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF CADMIUM[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	2	4	2	0	0.053	0.0076
Textile mills	NA	13	6[d]	2.5×10^{-5}	0.17	0.011
Timber products processing	BDL	7	1[d]	0	0.046	8.6×10^{-5}
Petroleum refining	<1	20	<2[d]	0	0.19	0.012
Paint and ink formulation	BDL	200	24	0	0.0011	3.8×10^{-5}
Gum and wood chemicals	NA	NA	NA	NA	NA	NA
Rubber processing	NA	1,500	760	0.00015	0.65	0.025
Auto and other laundries	<1.0	31	11	1.0×10^{-5}	0.015	0.002
Porcelain enameling	ND	2,000	650	0.0004	0.27	0.052
Pharmaceutical manufacturing	ND	ND	ND	ND	ND	ND
Ore mining and dressing	<0.002	16	<0.03	0	NA	0.001
Foundries	10	840	120	0	0.80	0.32
Iron and steel manufacturing	NA	770	270	0	NA	49
Nonferrous metals manufacturing	ND	3,000	780	0	NA	41

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CADMIUM[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gravity oil separation			NA	69	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			79->98	17	III.4.5
Gas flotation with chemical addition (polymer)			$0^{d,e}$	$-^{e}$	III.4.5
Gas flotation with chemical addition (alum, polymer)			$0^{d,e}$	$-^{e}$	III.4.5
Filtration			39->99	20	III.4.6
Sedimentation			72->99	210	III.4.2
Sedimentation with chemical addition (lime, polymer)			27-93	<16	III.4.3
Sedimentation with chemical addition (Fe^{2+}, lime)			25->50	6	III.4.3
Sedimentation with chemical addition (sulfide)			>50->99	<9	III.4.3
Sedimentation with chemical addition (polymer)			25-50	80	III.4.3
Sedimentation with chemical addition (alum, polymer)			42-61	33	III.4.3
Sedimentation with chemical addition (alum)			44-88	>9	III.4.3
Sedimentation with chemical addition (lime)			60-99	>9	III.4.3
Aerated lagoons			>97	<2	III.5.3
Ultrafiltration			>83->93	<8.3	III.4.7
Ozonation			$0^{d,e}$	$-^{e}$	III.6.14
Ion exchange			$>99^{d}$	$<10^{d}$	III.6.7
Activated sludge			31->99	4	III.5.1
Powdered activated carbon adsorption (with activated sludge)			$0^{d,e}$	$-^{e}$	III.6.2
Granular activated carbon adsorption			34-95	12	III.6.1
Reverse osmosis			13-50	13	III.6.9

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 255.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 9-1 - 9-20.

3. The Chemical Rubber Company. Handbook of Chemistry and Physics, 48th Edition. Cleveland, Ohio, 1967. p. B-104.

4. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. pp. B-97, B-98.

5. Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations. EPA-600/8-77-005, U.S. Environmental Protection Agency, Cincinnati, Ohio, May 1977. 73 pp.

Compound: Chromium Formula: Cr

Alternate Names [1]: Chrome (French)

CAS #: 7440-47-3

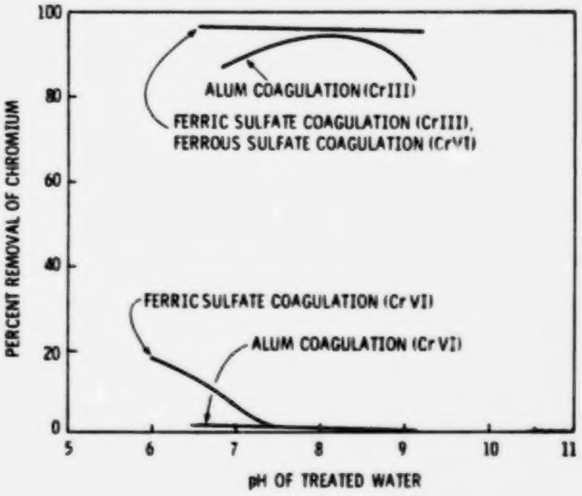
Physical, Chemical, and Biological Properties [2]

at. wt.: 52.00 m.p., °C: 1,860 b.p. (760 torr), °C: 2,670
vapor pressure (25°C), torr: Negligible
solubility in water (0°C), mg/L: CrO_3 (as H_2CrO_4), 6.17×10^5
common oxidation states: +2, +3, +6

Probable Fate [2]

photolysis: Not important
oxidation: Cr(VI) slowly transformed to more stable Cr(III), Cr (II) oxidizes readily to Cr(III)
hydrolysis: Cr(III) transformed to $Cr(OH)_3$ or Cr_2O_3 (both insoluble at neutral or alkaline pH)
volatilization: Not important
sorption: Cr(VI) adsorbed by organic materials; sorption of Cr(III) ancillary to precipitation of $Cr(OH)_3$
biological processes: Bioaccumulated by many aquatic organisms and passed on through the food chain; biotransformation is not important
other reactions/interactions: Not important

Precipitation/Coagulation Properties [3]



INDUSTRIAL OCCURRENCE OF CHROMIUM[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	8	530	260	0	6.9	0.98
Textile mills	NA	880	14[d]	5.9×10^{-5}	0.40	0.025
Timber products processing	BDL	14,000	20[e]	0	0.92	0.0017
Petroleum refining	1	2,000	26[d]	0	25	1.5
Paint and ink formulation	BDL	200,000	3,400	0	0.16	0.0054
Gum and wood chemicals	34	1,500	600	0.0054	4.5	0.99
Rubber processing	NA	140	250	5×10^{-8}	0.12	0.0046
Pulp, paper and paperboard mills	<1	24	<4	0	NA	0.12
Auto and other laundries	ND	8,800	180	0.00016	0.25	0.038
Porcelain enameling	ND	840	80	5×10^{-5}	0.033	0.006
Pharmaceutical manufacturing	ND	140	24	0	0.16	0.022
Ore mining and dressing	<10	25	<17	0	NA	<0.63
Steam electric power generating (condenser cooling system)	2	560	30	0.016	0.033	0.007
Steam electric power generating (water treatment)	20	NA	5,200[e]	3.2×10^{-8}	310	0.78
Steam electric power generating (boiler or steam generator blowdown)	NA	NA	20[e]	8.4×10^{-9}[e]	0.28	0.003
Steam electric power generating (maintenance cleaning)	ND	27,000	6,800	7×10^{-8}	129	2
Steam electric power generating (ash hauling)	BDL	1,000	19	0.0004	2	0.42
Steam electric power generating (air pollution control devices)	10	500	260	0.00024	15	0.94
Steam electric power generating (drainage)	ND	17,000	610	0.005	0.22	0.01
Inorganic chemicals manufacturing	NA	67,000	NA	0	4,200	840
Coal coating	40	330,000	36,000	2	65	17
Foundries	NA	430	93	0	0.62	0.25
Leather tanning and finishing	430	180,000	130,000	0	NA	195

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wasewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF CHROMIUM[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	13	70	38	0	1.0	0.14
Textile mills	NA	1,800	20[d]	8.4×10^{-5}	0.58	0.036
Timber products processing	1	6,600	30[d]	0	1.4	0.0026
Petroleum refining	1	1,230	50[d]	0	4.6	0.29
Paint and ink formulation	BDL	30,000	680	0	0.031	0.0011
Gum and wood chemicals	88	900	280	0.0025	2.1	0.46
Rubber processing	NA	220	110	2.2×10^{-5}	NA	0.36
Auto and other laundries	<5.0	170	61	5.5×10^{-5}	0.085	0.013
Porcelain enameling	ND	19	5	3.2×10^{-6}	0.0021	0.0004
Pharmaceutical manufacturing	ND	23	7.6	0	0.052	0.0070
Ore mining and dressing	<0.02	40	<0.02	0	NA	0.00074
Foundries	<20	150	33	0	0.22	0.089
Iron and steel manufacturing	NA	95,000	3,000	0	NA	540
Nonferrous metals manufacturing	ND	8,000	750	0	NA	40
Coil coating	3	2,800	780	0.039	1.4	0.37
Leather tanning and finishing	<20	20,000	4,200	0	NA	6.3

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CHROMIUM[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	1,700	III.4.1
Gas flotation			40-58	300	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			51-67	330	III.4.5
Gas flotation with chemical addition (polymer)			$0^{d,e}$	-^{e}	III.4.5
Gas flotation with chemical addition (alum, polymer)			19^{d}	360^{d}	III.4.5
Filtration			36->99	67	III.4.6
Sedimentation			79->99	1,200	III.4.2
Filtration, Cr^{+6}			0^{e}	-^{e}	III.4.6
Filtration, Cr^{+3}			95	610	III.4.6
Sedimentation with chemical addition (alum, lime)			72^{d}	31^{d}	III.4.3
Sedimentation with chemical addition (lime, polymer)			86-98	120	III.4.3
Sedimentation with chemical addition (lime, polymer), Cr^{+6}			41-82	8.5	III.4.3
Sedimentation with chemical addition (Fe^{2+}, lime)			>55->95	<3.3	III.4.3
Sedimentation with chemical addition (sulfide)			>97->99	40	III.4.3
Sedimentation with chemical addition (polymer)			>96-97	<14	III.4.3
Sedimentation with chemical addition ($BaCl_2$)			72-93	28	III.4.3
Sedimentation with chemical addition (alum, polymer)			69-95	70	III.4.3
Sedimentation with chemical addition (alum)			69-95	95	III.4.3
Sedimentation with chemical addition (lime)			49-97	340	III.4.3
Sedimentation with chemical addition (lime) chromium dissolved			$>99^{d}$	40^{d}	III.4.3
Tertiary polishing lagoons			$>71^{d}$	$<10^{d}$	III.5.3
Aerated lagoons			63-99	380	III.5.3
Trickling filters			$0^{d,e}$	-^{e}	III.5.2
Ultrafiltration			67^{d}	$2,900^{d}$	III.4.7
Ozonation			$0^{d,e}$	-^{e}	III.6.14
Ion exchange			$>99^{d}$	10^{d}	III.6.7
Activated sludge			45-99	910	III.5.1
Powdered activated carbon adsorption (with activated sludge)			87-97	55	III.6.2
Powdered activated carbon adsorption (with activated sludge), Cr^{+6}			41->64	<20	III.6.2
Granular activated carbon adsorption			34-95	60	III.6.1
Granular activated carbon adsoprtion Cr^{+6}			$>33^{d}$	$<20^{d}$	III.6.1
Reverse osmosis			44->99	460	III.6.9
Reverse osmosis Cr^{+6}			$0^{d,e}$	-^{e}	III.6.9
Reverse osmosis Cr^{+3}			$>99^{d}$	15^{d}	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 296.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 10-1 - 10-10.

3. Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations. EPA-600/8-77-005, U.S. Environmental Protection Agency, Cincinnati, Ohio, May 1977. 73 pp.

Compound: Copper **Formula:** Cu

Alternate Names [1]: Allbri natural copper, Bronze powder, Copper bronze, C.I. pigment metal 2

CAS #: 7440-54-8

Physical, Chemical, and Biological Properties [2-4]

at. wt.: 63.55 m.p., °C: 1,080 b.p. (760 torr), °C: 2,600
vapor pressure (25°C), torr: Negligible
solubility in water (0°C), mg/L: $CuCl_2$, 7.06×10^5
common oxidation states: +1, +2, +3

Probable Fate [2]

photolysis: Not important
oxidation: Cu(I) quickly oxidized in water; transformation Cu(II) to CuO and $Cu_2(OH)_2CO_3$ very pH-dependent
hydrolysis: CuO and $Cu_2(OH)_2CO_3$ formed, but less effective than sorption
volatilization: Not important
sorption: Sorbed by hydrous iron and manganese oxides, enhanced by complexing with ligands
biological processes: Bioaccumulated by all organisms, but not biomagnified; biotransformation not important
other reactions/interactions: Not important

Precipitation/Coagulation Properties: Not available

INDUSTRIAL OCCURRENCE OF COPPER[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	6	1,300	460	0	12	1.7
Textile mills	NA	2,400	40[d]	0.00017	1.1	0.072
Explosives manufacture	10	940	300	0	0.10	0.00013
Timber products processing	31	1,600	230[e]	0	10	0.020
Petroleum refining	2	1,400	26[d]	0	2.4	0.15
Paint and ink formulation	BDL	100,000	8,000	0	0.37	0.013
Gum and wood chemicals	33	6,000	1,800	0.016	14	3.0
Rubber processing	NA	120	200	4×10^{-9}	0.17	0.0066
Pulp, paper and paperboard mills	<1	40	<13	0	NA	0.39
Auto and other laundries	ND	11,000	413	0.00037	0.58	0.09
Porcelain enameling	1.0	12,000	2,500	0.0016	1.0	0.20
Pharmaceutical manufacturing	ND	180	43	0	0.29	0.040
Ore mining and dressing	<20	100	<61	0	NA	<2.2
Steam electric power generating (condenser cooling systems)	5	3,800	38	0.002	0.042	0.009
Steam electric power generating (water treatment)	20	NA	14,000[e]	8×10^{-5}	840	2.1
Steam electric power generating (boiler or steam generator blowdown)	20	190	40	1.7×10^{-8}	0.56	0.006
Steam electric power generating (maintenance cleaning)	170	1.2×10^{7}	160,000	0.0002	3,040	48
Steam electric power generating (ash handling)	12	80	21	0.00040	2.1	0.46
Steam electric power generating (air pollution control devices)	<2	560	281	0.00027	16	1.0
Steam electric power generating (drainage)	ND	3,400	880	0.0076	0.326	0.018
Inorganic chemicals manufacturing	NA	157,000[f]	NA	0	9,800	2,000
Coil coating	ND	480	35	0.0018	0.063	0.017
Foundries	ND	110,000	11,000	0	74	30
Leather tanning and finishing	35	740	200	0	NA	0.15
Nonferrous metals manufacturing	13	2.1×10^{6}	75,000	0	NA	4,000
Iron and steel manufacturing	NA	NA	915	0	NA	165

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segements.

INDUSTRIAL OCCURRENCE OF COPPER[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	6	9	7	0	0.18	0.026
Textile mills	NA	290	32[d]	0.00013	0.92	0.058
Timber products processing	18	4,000	92[d]	0	4.2	0.0079
Petroleum refining	3	300	10[d]	0	0.93	0
Paint and ink formulation	BDL	60,000	1,000	0	0.046	0.0016
Gum and wood chemicals	16	4,700	1,800	0.016	14	3.0
Explosives manufacture	NA	NA	NA	NA	NA	NA
Rubber processing	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	4	79	17	0	NA	0.51
Auto and other industries	21	330	129	0.0012	0.18	0.027
Porcelain enameling	ND	200	49	3.1×10^{-5}	0.020	0.0040
Pharmaceutical manufacturing	ND	65	21	0	0.14	0.019
Ore mining and dressing	<0.02	910	22	0	NA	0.81
Foundries	5.7	2,400	270	0	1.8	0.73
Iron and steel manufacturing	NA	76,000	780	0	NA	140
Nonferrous metals manufacturing	ND	300,000	21,000	0	NA	1,100
Coil coating	ND	17	12	0.006	0.022	0.0058
Leather tanning and finishing	5	37	15	0	NA	0.023

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR COPPER[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	100	III.4.1
Gas flotation			69[d]	5	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			78-91	300	III.4.5
Gas flotation with chemical addition (polymer)			42-75	66	III.4.5
Gas flotation with chemical addition (alum, polymer)			19[d]	660[d]	III.4.5
Filtration			40->99	200	III.4.6
Sedimentation			66->99	73	III.4.2
Sedimentation with chemical addition (alum, lime)			62-88	36	III.4.3
Sedimentation with chemical addition (lime, polymer)			87->99	56	III.4.3
Sedimentation with chemical addition (Fe^{2+}, lime)			72-92	21	III.4.3
Sedimentation with chemical addition (sulfide)			>98->99	260	III.4.3
Sedimentation with chemical addition (polymer)			56->89	140	III.4.3
Sedimentation with chemical addition ($BaCl_2$)			>62-73	<25	III.4.3
Sedimentation with chemical addition (alum, polymer)			49-80	6,900	III.4.3
Sedimentation with chemical addition (alum)			>64-81	<37	III.4.3
Sedimentation with chemical addition (lime)			75->99	52	III.4.3
Tertiary polishing lagoons			0[d,e]	-[e]	III.5.3
Aerated lagoons			49-94	40	III.5.3
Trickling filters			0[d,e]	-[e]	III.5.2
Ultrafiltration			>73-90	<700	III.4.7
Ozonation			0[e]	-[e]	III.6.14
Chemical oxidation (chlorination)			14[d]	320[d]	III.6.3
Ion exchange			98->99	95	III.6.7
Activated sludge			52->99	43	III.5.1
Powdered activated carbon adsorption (with activated sludge)			52-96	17	III.6.2
Granular activated carbon adsorption			47->85	<66	III.6.1
Reverse osmosis			73->99	1,600	III.6.9

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 306.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 11-1 - 11-19.

3. The Chemical Rubber Company. Handbook of Chemistry and Physics, 48th Edition. Cleveland, Ohio, 1967. p. B-108.

4. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. B-111.

Compound: Cyanides (Total)

Formula:
- Cyanide ion; CN^-
- Hydrogen cyanide; HCN (Prussic acid)
- Nitriles; RCN (R = organic group)

Alternate Names: None

CAS #: 57-12-5 for cyanide ion/74-90-8 for HCN

Physical, Chemical, and Biological Properties for HCN [1, 2]

mol. wt.: (HCN) 27.03 m.p., °C: -13.3 b.p. (760 torr), °C: 25.6
vapor pressure (20°C), torr: 620
solubility in water (25°C), mg/L: soluble in all proportions

Probable Fate [3]

photolysis: Presence of titanium dioxide causes rapid photooxidation of cyanide ion; otherwise, only some metallocyanides are photodecomposed
oxidation: Strong oxidizing agents are required to oxidize cyanides
hydrolysis: Too slow to compete with other fate mechanisms
volatilization: HCN, which composes almost all the total cyanides under natural conditions, is very rapidly volatilized
sorption: Cyanides are sorbed by most materials, but high solubility precludes strong adsorption
biological processes: Toxicity precludes bioaccumulation; almost all organisms biodegrade cyanides, but not as rapidly as volitalization
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF CYANIDES (Total)[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	5	5	0	0.13	0.019
Textile mills	NA	39	8[d]	3.4×10^{-5}	0.23	0.014
Explosives manufacture	10	2,600	810	0	0.28	0.0035
Petroleum refining	<5	1,500	<50[d]	0	46	0.29
Paint and ink formulation	BDL	2,000	200	0	0.0092	0.00032
Pulp, paper and paperboard mills	9	21	10	0	NA	0.30
Auto and other laundries	ND	1,000	63	6×10^{-5}	0.088	0.013
Porcelain enameling	4	140	30	2×10^{-5}	0.012	0.006
Pharmaceutical manufacturing	ND	1,000	181	0	1.2	0.17
Ore mining and dressing	<0.02	<0.02	<0.02	0	NA	0.00074
Steam electric power generating (condenser cooling system)	BDL	20	<20	<0.0011	<0.022	0.005
Steam electric power generating (water treatment)	5	NA	12,000[e]	7×10^{-5}	720	1.8
Steam electric power generating (boiler or steam generator blowdown)	5	14	10	4.2×10^{-9}	0.14	0.001
Steam electric power generating (maintenance cleaning)	NA	NA	NA	NA	NA	NA
Steam electric power generating (ash handling)	BDL	22	<20	0.0004	<2.0	0.44
Steam electric power generating (air pollution control devices)	NA	NA	NA	NA	NA	NA
Steam electric power generating (drainage)	NA	NA	NA	NA	NA	NA
Inorganic chemicals manufacturing	NA	2,800[f]	NA	0	175	35
Coil coating	ND	18,000	220	0.011	0.40	0.11
Foundries	ND	69	17	0	0.11	0.05
Leather tanning and finishing	ND	100	33	0	NA	0.05
Nonferrous metals manufacturing	<0.001	29	1.1	0	NA	0.058
Iron and steel manufacturing	NA	190,000	5,500	0	NA	9.90

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF CYANIDES (TOTAL)[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	5	50	10	0	0.26	0.038
Textile mills	NA	980	12[d]	5.0×10^{-5}	0.35	0.022
Petroleum refining	5	800	30[d]	0	2.8	0.17
Paint and ink formulation	BDL	530	40	0	0.0018	6.4×10^{-5}
Explosives manufacture	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	9	89	17	0	NA	0.51
Auto and other laundries	<0.002	88	13	1.2×10^{-5}	0.018	0.0027
Pharmaceutical manufacturing	ND	400	44	0	0.30	0.040
Ore mining and dressing	<0.01	81	<0.01	0	NA	0.00037
Foundries	1.0	180	31	0	0.21	0.084
Iron and steel manufacturing	NA	16,000	580	0	NA	100
Nonferrous metals manufacturing	<0.001	1.5	0.10	0	NA	0.005
Leather tanning and finishing	10	400	110	0	NA	0.17

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CYANIDES (TOTAL)^{a,b}

Treatment process^{a}	Synthetic wastewater Removal range,^{c} %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,^{c} %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	170	III.4.1
Gas flotation			$0^{d,e}$	$-^{e}$	III.4.3
Gas flotation with chemical addition (calcium chloride, polymer)			2-5	290	III.4.5
Gas flotation with chemical addition (polymer)			14^{d}	25^{d}	III.4.5
Gas flotation with chemical addition (alum, polymer)			$\geq 61^{d}$	$\leq 10^{d}$	III.4.5
Filtration			10->99	50	III.4.6
Sedimentation			31->90	330	III.4.2
Sedimentation with chemical addition (alum, lime)			>70-80	<17	III.4.3
Sedimentation with chemical addition (lime, polymer)			69-89	21	III.4.3
Sedimentation with chemical addition (alum, polymer)			$0^{d,e}$	$-^{e}$	III.4.3
Sedimentation with chemical addition (lime)			$0^{d,e}$	$-^{e}$	III.4.3
Aerated lagoons			45-91	100	III.5.3
Trickling filters			79^{d}	16^{d}	III.5.2
Ultrafiltration			$0^{d,e}$	$-^{e}$	III.4.7
Ozonation			81-99	2,100	III.6.14
Chemical oxidation			84->99	38	III.6.3
Ion exchange			>98->99	65	III.6.7
Activated sludge			18->90	520	III.5.1
Powdered activated carbon adsorption			>62-69	<28	III.6.2
Granular activated carbon adsorption			57->90	<20	III.6.1
Reverse osmosis			43-97	2,200	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 379.

2. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977.

3. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 12-1 - 12-12.

Compound: Lead   **Formula:** Pb

Alternate Names [1]: Pigment metal 4, Lead flake, Olow (Polish)

CAS #: 7439-92-1

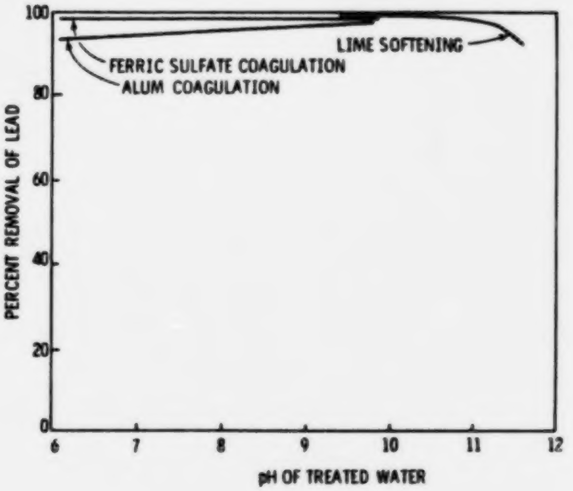
Physical, Chemical, and Biological Properties [2, 3]

at. wt.: 207.2   m.p., °C: 328   b.p. (760 torr), °C: 1,740
vapor pressure (25°C), torr: Negligible
solubility in water (20°C), mg/L: PbO, 17; $PbCl_2$, 9.9 x 10^3
common oxidation states: 0, +2, +4

Probable Fate [2]

photolysis: Not important
oxidation/reduction: Pb(IV) readily reduces to Pb(II); solubility control by $PbSO_4$ at low pH and by $PbCO_3$ at high pH
hydrolysis: Not important at pH <11.5
volatilization: Importance of volatilization of $(CH_3)_4Pb$ unknown in natural condition
sorption: Pb removed to sediments effectively by inorganic solids, hydrous iron oxides and crystalline structures
biological processes: Bioaccumulation by aquatic organisms and biomethylation by microbes
other reactions/interactions: Not important

Precipitation/Coagulation Properties [4]



INDUSTRIAL OCCURRENCE OF LEAD[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	20	70	170	0	9.8	1.4
Textile mills	NA	750	35[d]	0.00015	1.0	0.063
Explosives manufacture	ND	110	25	0	0.0087	0.00011
Timber products processing	1	91	16	0	0.74	0.0014
Petroleum refining	2	960	<60[d]	0	5.6	0.35
Paint and ink formulation	BDL	900,000	86,000	0	3.9	0.14
Gum and wood chemicals	11	72	20	0.00018	0.15	0.033
Rubber processing	NA	390	120	2.4×10^{-5}	0.10	0.0040
Pulp, paper and paperboard mills	<1	38	<6	0	NA	0.18
Auto and other laundries	ND	22,000	860	0.0007	1.2	0.18
Porcelain enameling	150	880,000	2,900	0.0019	1.2	0.23
Pharmaceutical manufacturing	ND	46	7.9	0	0.054	0.0073
Ore mining and dressing	<20	60	<45	0	NA	<1.7
Steam electric power generating (condenser cooling system)	BDL	800	13	0.00069	0.014	0.003
Steam electric power generating (water treatment)	NA	12,000[e]	NA	4×10^{-5}	360	0.9
Steam electric power generating (boiler or steam generator blowdown)	NA	NA	NA	NA	NA	NA
Steam electric power generating (maintenance cleaning)	<10	5,200	440	4×10^{-7}	8.4	0.13
Steam electric power generating (ash handling)	BDL	70	30	0.0006	2.9	0.66
Steam electric power generating (air pollution control devices)	10	520	270	0.0003	15	0.97
Steam electric power generating (drainage)	NA	NA	30[e]	0.00026	0.011	0.0006
Inorganic chemicals manufacturing	NA	160,000[f]	NA	0	9,800	2,000
Coil coating	ND	2,100	230	0.011	0.414	0.11
Foundries	ND	140,000	7,700	0	5.1	21
Leather tanning and finishing	60	3,500	680	0	NA	1.0
Nonferrous metals manufacturing	ND	2.7×10^7	960,000	0	NA	51,000
Iron and steel manufacturing	NA	25,000	3,100	0	NA	560

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF LEAD[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	<20	270	<60	0	1.6	0.23
Textile mills	NA	120	46[d]	0.00019	1.3	0.0072
Timber products processing	BDL	37	4[d]	0	0.18	0.00034
Petroleum refining	1	107	28[d]	0	2.6	0.16
Paint and ink formulation	BDL	40,000	670	0	0.031	0.0011
Gum and wood chemicals	BDL	19	11	0.000099	0.083	0.0017
Rubber processing	NA	9[e]	9[e]	1.8×10^{-6}	0.0077	0.00030
Explosives manufacture	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	<1	95	<14	0	NA	0.42
Auto and other industries	11	910	255	0.00023	0.36	0.054
Porcelain enameling	ND	3,000	700	0.00045	0.29	0.056
Pharmaceutical manufacturing	ND	10	2.0	0	0.014	0.0018
Ore mining and dressing	<0.01	560	<0.10	0	NA	0.0037
Foundries	10	8,500	840	0	5.6	2.3
Iron and steel manufacturing	NA	5,500	480	0	NA	86
Nonferrous metals manufacturing	ND	26,000	4,000	0	NA	210
Coil coating	ND	110	38	0.0019	0.068	0.018
Leather tanning and finishing	8	80	43	0	NA	0.065

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concetration by industry wastewater discharges as reported in Section I.2; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR LEAD[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	150	III.4.1
Gas flotation			49-82	110	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			97-98	150	III.4.5
Gas flotation with chemical addition (polymer)			15->29	<40	III.4.5
Gas flotation with chemical addition (alum, polymer)			0[d,e]	-[e]	III.4.5
Filtration			36->99	140	III.4.6
Sedimentation			69->99	420	III.4.6
Sedimentation with chemical addition (alum, lime)			50[d]	<200[d]	III.4.3
Sedimentation with chemical addition (lime, polymer)			>72-98	210	III.4.3
Sedimentation with chemical addition (Fe^{2+}, lime)			>40->96	<3	III.4.3
Sedimentation with chemical addition (sulfide)			>93-96	100	III.4.3
Sedimentation with chemical addition (polymer)			>52-97	77	III.4.3
Sedimentation with chemical addition ($BaCl_2$)			42-83	40	III.4.3
Sedimentation with chemical addition (alum, polymer)			>74->96	<320	III.4.3
Sedimentation with chemical addition (alum)			6-18	120	III.4.3
Sedimentation with chemical addition (lime)			60-99	51	III.4.3
Tertiary polishing lagoons			>72[d]	<10[d]	III.5.3
Aerated lagoons			86-93	<50	III.5.3
Trickling filters			0[d,e]	-[e]	III.5.2
Ultrafiltration			>74->95	<1,000	III.4.7
Ozonation			>29[d]	<22[d]	III.6.14
Chemical oxidation			0[d,e]	-[e]	III.6.3
Ion exchange			99[d]	10[d]	III.6.7
Activated sludge			49-99	40	III.5.1
Powdered activated carbon adsorption (with activated sludge)			39->78	<28	III.6.2
Granular activated carbon adsorption			14->72	46	III.6.1
Reverse osmosis			31->99	210	III.6.9

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 515.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 13-1 - 13-19.

3. The Chemical Rubber Company. Handbook of Chemistry and Physics, 48th Edition. Cleveland, Ohio, 1967. p. B-118.

4. Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations. EPA-600/8-77-005, U.S. Environmental Protection Agency, Cincinnati, Ohio, May 1977. 73 pp.

Compound: Mercury **Formula:** Hg

Alternate Names [1]: Quick silver; Liquid silver

CAS #: 7439-97-6

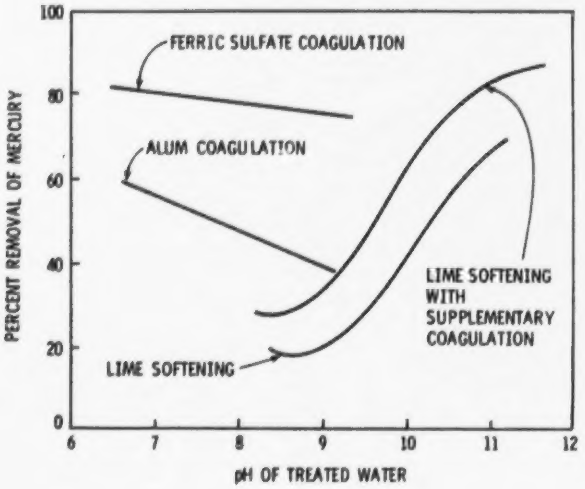
Physical, Chemical, and Biological Properties [2-4]

at. wt.: 200.6 m.p., °C: -38.9 b.p. (760 torr), °C: 357
vapor pressure (25°C), torr: 0.002
solubility in water, mg/L: HgO, 53 at 25°C; HgS (α), 0.01 at 18°C;
HgS (β), insoluble; $HgCl_2$, 6.9×10^4 at 20°C
common oxidation states: 0, +1, +2

Probable Fate [2]

photolysis: Breakdown of atmospheric dimethyl mercury to methyl mercury of slight importance
oxidation/reduction: Oxidation of metallic mercury forms ionic mercury (later adsorbed); reduction forms HgS precipitate
hydrolysis: Not important
volatilization: Metallic Hg, methylated Hg, and adsorbed Hg all volatilizable
sorption: Hg is adsorbed by most particles, buried in sediment, and reduced to HgS
biological processes: Bioaccumulated by all organisms and readily methylated metabolically
other reactions/interactions: Not important

Precipitation/Coagulation Properties [5]



INDUSTRIAL OCCURRENCE OF MERCURY[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	0.003[d]	0.003[d]	0	7.9×10^{-5}	1.1×10^{-5}
Textile mills	NA	4	0.6[e]	2.5×10^{-6}	0.017	0.0011
Timber products processing	BDL	18	2[f]	0	0.092	0.00017
Petroleum refining	<0.1	6	<0.5[e]	0	0.046	0.0029
Paint and ink formulation	BDL	120,000	5,200	0	0.24	0.0083
Rubber processing	NA	720	120	2.4×10^{-5}	0.10	0.0040
Pulp, paper, paperboard mills	<1	3	<1	0	NA	0.030
Auto and other laundries	ND	51	2	2×10^{-6}	0.003	0.004
Porcelain enameling	1	1	1	6×10^{-7}	0.0004	8×10^{-5}
Pharmaceutical manufacturing	ND	1.3	0.15	0	0.001	0.001
Ore mining and dressing	<0.5	<84	<17	0	NA	0.63
Steam electric power generating (condenser cooling systems)	0.17	0.42	0.34	2×10^{-5}	0.0004	0.001
Steam electric power generating (water treatment)	NA	NA	470[f]	2.9	28	0.07
Steam electric power generating (boiler or steam generator blowdown)	NA	NA	NA	NA	NA	NA
Steam electric power generating (maintenance cleaning)	0.02	15,000	1	1×10^{-9}	0.019	0.0003
Steam electric power generating (ash handling)	BDL	1.5	<0.5	9.6×10^{-6}	0.050	0.011
Steam electric power generating (air pollution control devices)	0.1	70	35	3.3×10^{-5}	2	0.13
Steam electric power generating (drainage)	NA	NA	1	8.6×10^{-6}	2×10^{-5}	0.00037
Coil coating	<10[d]	<10[d]	<10[d]	<0.0005	<0.018	<0.0048
Foundries	ND	9	0.64	0	0.004	0.0017
Iron and steel manufacturing	NA	1,300	70	0	NA	13
Nonferrous metals manufacturing	ND	52	7.6	0	NA	0.40
Inorganic chemicals manufacturing	NA	3,500[g]	NA	0	219	44

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] One sample.

[e] Median, not average.

[f] Average of medians reported for various industry segments.

[g] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF MERCURY[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	0.001	<0.001	0	2.6×10^{-5}	3.8×10^{-6}
Textile mills	NA	0.7	0.4[d]	1.7×10^{-6}	0.011	0.00072
Timber products processing	BDL	2	1[d]	0	0.046	8.6×10^{-5}
Petroleum refining	<0.1	6	<0.5[d]	0	0.046	0.0029
Paint and ink formulation	BDL	4,400	830	0	0.038	1.3×10^{-5}
Rubber processing	NA	4.7	1.4	2.8×10^{-7}	0.0012	4.6×10^{-5}
Pulp, paper and paperboard mills	NA	1	<1	0	NA	0.030
Auto and other laundries	<0.2	5.6	1.7	1.5×10^{-6}	0.0024	0.00036
Pharmaceutical manufacturing	ND	6.4	0.50	0	0.0034	0.00046
Ore mining and dressing	<0.001	28	<0.002	0	NA	7.4×10^{-5}
Foundries	0.3	<20	6.4	0	0.043	0.017
Iron and steel manufacturing	NA	500	23	0	NA	4.1
Nonferrous metals manufacturing	ND	12	1.3	0	NA	0.07

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR MERCURY[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	1.4	III.4.1
Gas flotation			0[d,e]	-[e]	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			>68->90	<0.8	III.4.5
Gas flotation with chemical addition (alum, polymer)			33[d]	1[d]	III.4.5
Filtration			45-86	340	III.4.6
Sedimentation			50->99	6.1	III.4.2
Sedimentation with chemical addition (alum, lime)			71	2	III.4.3
Sedimentation with chemical addition (lime, polymer)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (Fe^{2+}, lime)			>30->60	<0.2	III.4.3
Sedimentation with chemical addition (sulfide)			>99[d]	20[d]	III.4.3
Sedimentation with chemical addition (polymer)			>62-99	70	III.4.3
Sedimentation with chemical addition ($BaCl_2$)			87[d]	0.5[d]	III.4.3
Sedimentation with chemical addition (alum, polymer)			71-88	5,200	III.4.3
Sedimentation with chemical addition (alum)			>34->62	<76	III.4.3
Sedimentation with chemical addition (lime)			35->96	1.4	III.4.3
Aerated lagoons			>99[d]	0.1[d]	III.5.3
Ultrafiltration			15-20	0.6	III.4.7
Activated sludge			30-87	<0.8	III.5.1
Powdered activated carbon adsorption			0[d,e]	-[e]	III.6.2
Granular activated carbon adsorption			33->99	1.6	III.6.1
Reverse osmosis			22->60	0.5	III.6.9

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 526.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 14-1 - 14-15.

3. The Chemical Rubber Company. Handbook of Chemistry and Physics, 48th Edition. Cleveland, Ohio, 1967. p. B-120.

4. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. B-132.

5. Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations. EPA-600/8-77-005, U.S. Environmental Protection Agency, Cincinnati, Ohio, May 1977. 73 pp.

Compound: Nickel Formula: Ni

Alternate Names [1]: Nickel sponge, Pulverized nickel, Raney nickel, Carbonyl nickel powder

CAS #: 7440-02-0

Physical, Chemical, and Biological Properties [2, 3]

at. wt.: 58.71 m.p., °C: 1,450 b.p. (760 torr), °C: 2,730
vapor pressure (25°C), torr: Negligible
solubility in water, mg/L: NiS, 3.6 at 18°C; $NiCl_2$, 6.42×10^5 at 20°C
common oxidation states: +2

Probable Fate [2]

photolysis: Not important
oxidation: Under reducing conditions with sulfur, NiS is formed; otherwise unimportant
hydrolysis: Hydrolysis under natural conditions removes no nickel from solution
volatilization: Not important
sorption: Ni coprecipitates with hydrous metal oxides, and to a lesser degree is adsorbed by organic matter and incorporated in crystalline minerals
biological processes: Slightly bioaccumulated; no biotransformation noted
other reactions/interactions: Not important

Precipitation/Coagulation Properties: Not available

INDUSTRIAL OCCURRENCE OF NICKEL[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	<5	1,000	<550	0	14	2.1
Textile mills	NA	300	54[d]	0.00023	1.6	0.097
Explosives manufacture	ND	100	50	0	0.017	0.00021
Timber products processing	3	270	15[e]	0	0.69	0.0013
Petroleum refining	1	771	40[d]	0	3.7	0.23
Paint and ink formulation	BDL	40,000	530	0	0.024	0.00085
Gum and wood chemicals	19	100	38	0.00034	0.29	0.063
Rubber processing	NA	590	210	4.2×10^{-5}	0.18	0.0069
Pulp, paper, paperboard mills	<1	29	<5	0	NA	0.15
Auto and other laundries	ND	2,400	130	0.00011	0.027	0.027
Porcelain enameling	250	67,000	14,000	0.009	5.7	1.1
Pharmaceutical manufacturing	ND	200	35	0	0.24	0.032
Ore mining and dressing	<20	<75	<33	0	NA	1.2
Steam electric power generating (condenser cooling system)	4	200	22	0.0011	0.024	0.0053
Steam electric power generating (water treatment)	30	NA	6,600[e]	0.00004	396	1.0
Steam electric power generating (boiler or steam generator blowdown)	NA	NA	30	1.3×10^{-8}	0.42	0.0045
Steam electric power generating (maintenance cleaning)	ND	900,000	89,000	8.9×10^{-5}	1,691	26.7
Steam electric power generating (ash handling)	2.5	490	34	0.00065	3.3	0.75
Steam electric power generating (air pollution control devices)	50	1,500	780	0.00074	44	2.8
Steam electric power generating (drainage)	ND	ND	ND	ND	ND	ND
Inorganic chemicals manufacturing	NA	110,000[f]	NA	0	6,875	1,375
Coil coating	ND	3,200	400	0.02	0.72	0.19
Foundries	ND	NA	200	0	1.3	0.54
Leather tanning and finishing	5	100	52	0	NA	0.30
Iron and steel manufacturing	NA	120,000	5,000	0	NA	900
Nonferrous metals manfacturing	ND	3.1×10^{6}	91,000	0	NA	4,800

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF NICKEL[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	<5	100	<14	0	0.37	0.053
Textile mills	NA	150	70[d]	0.00029	2.0	0.13
Timber products processing	2	150	18[d]	0	0.83	0.0015
Petroleum refining	<1	74	<15[d]	0	1.4	0.087
Paint and ink formulation	BDL	80,000	1,800	0	0.083	0.0029
Gum and wood chemicals	43	1,100	380	0.0034	2.9	0.63
Explosives manufacture	NA	NA	NA	NA	NA	NA
Rubber processing	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	<1	17	<6.3	0	NA	0.19
Auto and other laundries	23	330	76	6.8×10^{-5}	0.11	0.016
Porcelain enameling	ND	1,000	560	0.00036	0.23	0.045
Pharmaceutical manufacturing	ND	110	31	0	0.21	0.028
Ore mining and dressing	<0.05	2.4	<0.97	0	NA	0.036
Foundries	<20	130	41	0	0.27	0.11
Iron and steel manufacturing	NA	6,800	750	0	NA	140
Nonferrous metals manufacturing	ND	310,000	24,000	0	NA	1,300
Coil coating	ND	120	30	0.0015	0.054	0.014
Leather tanning and finishing	4	34	24	0	NA	0.035

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR NICKEL[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	69	III.4.1
Gas flotation			0[d,e]	-[e]	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			>65->94	<73	III.4.5
Gas flotation with chemical addition (polymer)			0[e]	-[e]	III.4.5
Gas flotation with chemical addition (alum, polymer)			41[d]	270[d]	III.4.5
Filtration			31->99	64	III.4.6
Sedimentation			59->99	<180	III.4.2
Sedimentation with chemical addition (alum, lime)			>83[d]	<1[d]	III.4.3
Sedimentation with chemical addition (lime, polymer)			86-96	240	III.4.3
Sedimentation with chemical addition (lime, polymer) Ni dissolved			99[d]	2,500[d]	III.4.3
Sedimentation with chemical addition (Fe^{2+}, lime)			>35->95	3	III.4.3
Sedimentation with chemical addition (sulfide)			>88-96	860	III.4.3
Sedimentation with chemical addition (polymer)			35[d]	43[d]	III.4.3
Sedimentation with chemical addition (alum, polymer)			35->97	17,000	III.4.3
Sedimentation with chemical addition (alum)			>27->56	<36	III.4.3
Sedimentation with chemical addition (lime)			40-99	540	III.4.3
Sedimentation with chemical addition (lime) Ni dissolved			>99[d]	20[d]	III.4.3
Aerated lagoons			17-50	34	III.5.3
Ultrafiltration			>32[d]	<500	III.4.7
Ozonation			0[e]	-[e]	III.6.14
Ion exchange			>99	<10	III.6.7
Activated sludge			29-92	78	III.5.1
Powdered activated carbon adsorption (with activated sludge)			19->58	<14	III.6.2
Granular activated carbon adsorption			17-68	110	III.6.1
Reverse osmosis			46->98	66	III.6.9

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 590.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 15-1 - 15-9.

3. The Chemical Rubber Company. Handbook of Chemistry and Physics, 48th Edition. Cleveland, Ohio, 1967. p. B-123.

Compound: Selenium   Formula: Se

Alternate Names [1]: Selenium dust

CAS #: 7782-49-2

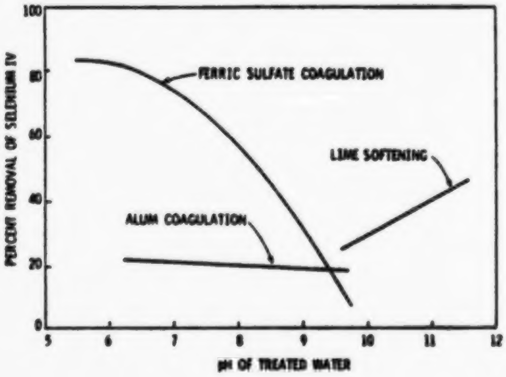
Physical, Chemical, and Biological Properties [2, 3]

at. wt.: 78.96   m.p., °C: 217 (metallic form)   b.p. (760 torr), °C: 685
vapor pressure (25°C), torr: Negligible
solubility in water (14°C), mg/L: SeO_2, 3.84×10^5; SeO_3 decomposes, very soluble
common oxidation states: -2, 0, +4, +6

Probable Fate [2]

photolysis: Not important
oxidation: In aerobic waters, soluble anions are formed; under reducing conditions, selenium or metal selenides (insoluble) go into sediment, possibly forming volatile H_2Se
hydrolysis: SeO_4^{-2}, SeO_4^{-2}, and $HSeO_3^-$ (all soluble) are formed
volatilization: H_2Se can be formed; volatilization can also follow biomethylation
sorption: Adsorbed by hydrous metal oxides (strongly), clays, and organic chemicals, but only a small percentage of total Se is sorbed
biological processes: Bioaccumulation by many species; possible biological redox reactions, and some biomethylation
other reactions/interactions: Not important

Precipitation/Coagulation Properties [4]



INDUSTRIAL OCCURRENCE OF SELENIUM[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	2	34	6	0	0.16	0.023
Textile mills	NA	740	35[d]	0.00015	1.0	0.063
Timber products processing	BDL	53	3[e]	0	0.14	0.00026
Petroleum refining	<1	<20	<8[d]	0	0.74	0.046
Gum and wood chemicals	NA	11	11	9.9×10^{-5}	0.083	0.018
Rubber processing	NA	20	11	2.2×10^{-6}	0.0095	0.00036
Auto and other laundries	ND	120	5	4.5×10^{-6}	0.007	0.001
Porcelain enameling	1	160,000	9,800	0.006	4	0.80
Pharmaceutical manufacturing	ND	60	6	0	0.041	0.005
Ore mining and dressing	<5	<30	<8.3	0	NA	0.30
Steam electric power generating (condenser cooling system)	<5	28	9	0.00048	0.010	0.0022
Steam electric power generating (water treatment)	NA	NA	58,000[e]	0.00035	3,480	8.7
Steam electric power generating (boiler or steam generator blowdown)	NA	NA	NA	NA	NA	NA
Steam electric power generating (maintenance cleaing)	<2	24	2	3×10^{-7}	0.038	0.0006
Steam electric power generating (ash handling)	3	42	8	0.00015	0.78	0.18
Steam electric power generating (air pollution control devices)	<0.6	2,700	1,400	0.001	80	5
Steam electric power generating (drainage)	NA	NA	NA	NA	NA	NA
Inorganic chemicals manufacturing	NA	93[f]	NA	0	5.9	1.1
Foundries	ND	NA	<8	0	<0.054	<0.022
Iron and steel manufacturing	ND	670	67	0	NA	12
Nonferrous metals manufacturing	ND	240,000	950	0	NA	50

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF SELENIUM[a,b]

Industry	Treated wastewater: Concentration, μg/L Minimum	Concentration, μg/L Maximum	Concentration, μg/L Mean	Loading,[c] kg/d Minimum	Loading,[c] kg/d Maximum	Loading,[c] kg/d Mean
Coal mining	<2	20	<4	0	0.11	0.015
Textile mills	NA	97	47[d]	0.00020	1.3	0.085
Timber products processing	BDL	39	1[d]	0	0.046	8.6×10^{-5}
Petroleum refining	<2	27	<16[d]	0	1.5	0.093
Gum and wood chemicals	BDL	19	10	0.000096	0.076	0.016
Rubber processing	NA	24	13	2.6×10^{-6}	0.011	0.00043
Auto and other laundries	<1.0	7.0	3.8	3.4×10^{-5}	0.0053	0.00080
Porcelain enameling	ND	84	20	1.3×10^{-5}	0.0082	0.0016
Pharmaceutical manufacturing	ND	310	34	0	0.23	0.031
Ore mining and dressing	<0.003	.15	<0.0050	NA	0.00020	
Foundries	9.5	<20	18.5	0	0.12	0.05
Iron and steel manufacturing	NA	630	45	0	NA	8.1
Nonferrous metals manufacturing	ND	2,300	180	0	NA	9.5

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR SELENIUM[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	20	III.4.1
Gas flotation			$0^{d,e}$	$-^{e}$	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			$0^{d,e}$	$-^{e}$	III.4.5
Gas flotation with chemical addition (alum, polymer			$0^{d,e}$	$-^{e}$	III.4.5
Filtration			2-10	48	III.4.6
Sedimentation			60->99	<20	III.4.2
Sedimentation with chemical addition (lime, polymer)			0^{e}	$-^{e}$	III.4.3
Sedimentation with chemical addition (Fe^{2+}, lime)			18-24	20	III.4.3
Sedimentation with chemical addition ($BaCl_2$)			$0^{d,e}$	$-^{e}$	III.4.3
Sedimentation with chemical addition (lime)			0^{e}	$-^{e}$	III.4.3
Tertiary polishing lagoons			44^{d}	18^{d}	III.5.3
Aerated lagoons			$>50^{d}$	$<200^{d}$	III.5.3
Activated sludge			$0^{d,e}$	$-^{e}$	III.5.1
Powdered activated carbon adsorption (with activated sludge)			6->13	<30	III.6.2
Granular activated carbon adsorption			17->50	19	III.6.1
Reverse osmosis			>76-85	5.5	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 852.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 16-1 - 16-13.

3. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. B-46.

4. Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations. EPA-600/8-77-005, U.S. Environmental Protection Agency, Cincinnati, Ohio, May 1977. 73 pp.

Compound: Silver **Formula:** Ag

Alternate Names [1]: Argentium, Shell silver

CAS #: 7440-22-4

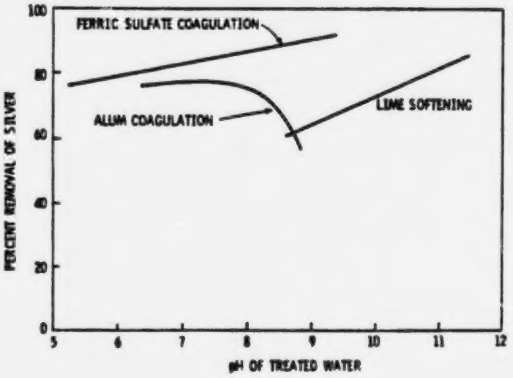
Physical, Chemical, and Biological Properties [2, 3]

at. wt.: 107.9 m.p., °C: 962 b.p. (760 torr), °C: 2,210
vapor pressure (25°C), torr: Negligible
solubility in water, mg/L: Ag_2O, 13 at 20°C; AgCl, 0.89 at 10°C
common oxidation states: +1 (principal state), +2, +3

Probable Fate [2]

photolysis: Not important in aquatic environment
oxidation: Ag and Ag^+ compounds (most insoluble) only forms usually present (both precipitate)
hydrolysis: Important only at high pH, where Ag_2O may precipitate
volatilization: Not important
sorption: Strongly sorbed by MnO_2, then released in saline water; some sorption by clays and organic materials
biological processes: Bioaccumulated by many aquatic organisms
other reactions/interactions: Not important

Precipitation/Coagulation Properties [4]



INDUSTRIAL OCCURRENCE OF SILVER[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	<2	10	<6	0	0.16	0.023
Textile mills	NA	130	32[d]	0.00013	0.92	0.058
Explosives manufacture	ND	2	1.0	0	0.00035	4.3×10^{-6}
Timber products processing	BDL	7	1[e]	0	0.046	0.000086
Petroleum refining	<1	<250	<25	0	2.3	0.14
Paint and ink formulation	BDL	200	12	0	0.00055	1.9×10^{-5}
Auto and other laundries	ND	130	12	1.1×10^{-5}	0.017	0.0025
Pharmaceutical manufacturing	NA	NA	NA	NA	NA	NA
Ore mining and dressing	<10	<50	16	0	NA	<0.59
Steam electric power generating (condenser cooling system)	0.7	80	4	0.00021	0.0044	0.00096
Steam electric power generating (water treatment)	NA	NA	5,000[e]	0.000030	300	0.75
Steam electric power generating (boiler or steam generator blowdown)	NA	NA	NA	NA	NA	NA
Steam electric power generating (maintenance cleaning)	10	70	25	2.5×10^{-9}	0.48	0.008
Steam electric power generating (ash handling)	0.5	6	3.3	6.3×10^{-8}	0.32	0.073
Steam electric power generating (air pollution control devices)	5	600	300	0.00029	17	1.1
Steam electric power generating (drainage)	NA	NA	NA	NA	NA	NA
Inorganic chemicals manufacturing	NA	280[f]	NA	0	18	3.5
Coil coating	20[g]	20[g]	20[g]	0.001	0.036	0.010
Foundries	ND	NA	30	0	0.20	0.081
Iron and steel manufacturing	NA	670	48	0	NA	8.6
Nonferrous metals manufacturing	ND	4,700	320	0	NA	17

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segments.

[g] One sample.

INDUSTRIAL OCCURRENCE OF SILVER[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	2	10	5	0	0.13	0.019
Textile mills	NA	140	25[d]	0.00010	0.72	0.045
Timber products processing	BDL	4	BDL	–[e]	–[e]	–[e]
Petroleum refining	<1	<25	<5[d]	0	0.46	0.029
Paint and ink formulation	BDL	100,000	6,700	0	0.31	0.011
Explosives manufacture	NA	NA	NA	NA	NA	NA
Auto and other laundries	<1.0	7.0	4.0	0.0000036	0.0056	0.00084
Ore mining and dressing	<0.02	<0.02	<0.02	0	NA	7.4×10^{-5}
Foundries	NA	<20[f]	<20[f]	0	0.13	0.054
Iron and steel manufacturing	NA	500	57	0	NA	10
Nonferrous metals manufacturing	ND	7,000	530	0	NA	28

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Mean pollutant concentration below detection limit.

[f] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR SILVER[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	120	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			24->48	<13	III.4.5
Gas flotation with chemical addition (polymer)			0[d,e]	-[e]	III.4.5
Gas flotation with chemical addition (alum, polymer)			44[d]	66[d]	III.4.5
Filtration			11->50	22	III.4.6
Sedimentation			78->99	<45	III.4.6
Sedimentation with chemical addition (lime, polymer)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (Fe^{2+}, lime)			>79->97	12	III.4.3
Sedimentation with chemical addition (sulfide)			>90->99	<25	III.4.3
Sedimentation with chemical addition ($BaCl_2$)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (alum, polymer)			21[d]	11[d]	III.4.3
Sedimentation with chemical addition (alum)			5-10	120	III.4.3
Sedimentation with chemical addition (lime)			24->80	<4	III.4.3
Ozonation			0[e]	-[e]	III.6.14
Ion exchange			>99	<10	III.6.7
Activated sludge			31->96	32	III.5.1
Granular activated carbon adsorption			7-36	21	III.6.1
Reverse osmosis			31-92	25	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 858.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 17-1 - 17-11.

3. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. B-47.

4. Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations. EPA-600/8-77-005, U.S. Environmental Protection Agency, Cincinnati, Ohio, May 1977. 73 pp.

Compound: Thallium Formula: Tl

Alternate Names [1]: Thallium salt

CAS #: 7440-28-0

Physical, Chemical, and Biological Properties [2,3]

mol. wt.: 204.4 m.p., °C: 304 b.p. (760 torr), °C: 1,460
vapor pressure (25°C), torr: Negligible
solubility in water, mg/L: Tl_2S, 2.0×10^2 at 20°C; TlCl, 2.9×10^3 at 16°C
common oxidation states: +1, +3

Probable Fate [2]

photolysis: Not important
oxidation: Tl(III) present only in very oxidizing water; in reducing conditions, metallic Tl or sulfide may precipitate
hydrolysis: Hydrolysis of Tl^{3+} to insoluble $Tl(OH)_3$ unimportant because of low Tl^{3+} content of natural water
sorption: Tl^+ adsorbed strongly by clay minerals and to a lesser degree by hydrous metal oxides
biological processes: Quickly bioaccumulated by aquatic organisms
other reactions/interactions: Not important

Precipitation/Coagulation Properties: Not available

INDUSTRIAL OCCURRENCE OF THALLIUM[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	<5	15	<7	0	0.18	0.026
Textile mills	NA	9	3[d]	1.3×10^{-5}	0.087	0.0054
Timber products processing	BDL	10	1[e]	0	0.046	8.6×10^{-5}
Petroleum refining	<1	<15	<1[d]	0	0.093	0.0058
Paint and ink formulation	BDL	200	10	0	0.00046	1.6×10^{-5}
Auto and other laundries	ND	6	4	3.6×10^{-5}	0.0056	0.00084
Pharmaceutical manufacturing	ND	24	3.0	0	0.020	0.0028
Ore mining and dressing	<100	<100	<100	0	NA	<3.7
Steam electric power generating (condenser cooling system)	BDL	13	2.5	0.00013	0.0028	0.00060
Steam electric power generating (water treatment)	NA	NA	5,000[e]	3×10^{-5}	300[e]	0.75
Steam electric power generating (boiler or steam generator blowdown)	NA	NA	NA	NA	NA	NA
Steam electric power generating (maintenance cleaning)	NA	NA	NA	NA	NA	NA
Steam electric power generating (ash handling)	BDL	9	BDL	BDL	BDL	BDL
Steam electric power generating (air pollution control devices)	NA	NA	NA	NA	NA	NA
Steam electric power generating (drainage)	NA	NA	NA	NA	NA	NA
Inorganic chemicals manufacturing	NA	150[f]	NA	0	9.4	2.0
Iron and steel manufacturing	NA	NA	19	0	NA	3.4
Nonferrous metals manufacturing	ND	620	170	0	NA	33

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF THALLIUM[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	<5	6	<5	0	0.13	0.019
Textile mills	NA	18	3[d]	1.3×10^{-5}	0.087	0.0054
Timber products processing	BDL	7	BDL	-[e]	-[e]	-[e]
Petroleum refining	<1	<15	<4[d]	0	0.37	0.023
Paint and ink formulation	BDL	100	11	0	0.00051	1.8×10^{-5}
Auto and other laundries	<1.0	<5.0	2.8	2.5×10^{-6}	0.0039	0.00060
Pharmaceutical manufacturing	ND	ND	ND	ND	ND	ND
Ore mining and dressing	<0.01	<0.05	<0.01	0	NA	<0.00037
Foundries	<20	<20	<20	0	0.13	0.054
Iron and steel manufacturing	NA	60	16	0	NA	2.9
Nonferrous metals manufacturing	ND	800	140	0	NA	7.4

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR THALLIUM[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	2	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			0[d,e]	-[e]	III.4.5
Gas flotation with chemical addition (polymer)			0[d,e]	-[e]	III.4.5
Filtration			>55[d]	<10[d]	III.4.6
Sedimentation			>55->83	<5	III.4.2
Sedimentation with chemical addition (Fe^{2+}, lime)			>55->88	<4	III.4.3
Sedimentation with chemical addition (lime)			>52->88	3.4	III.4.3
Aerated lagoons			>44->80	<16	III.4.3
Activated sludge			38[d]	29[d]	III.5.1
Granular activated carbon adsorption					III.6.1
Reverse osmosis			70-89	3.5	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 891.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 18-1 - 18-8.

3. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. B-51.

Compound: Zinc Formula: Zn

Alternate Names [1]: Blue powder, C.I. Pigment-black 16

CAS #: 7440-66-6

Physical, Chemical, and Biological Properties [2, 3]

mol. wt.: 65.38 m.p., °C: 420 b.p. (760 torr), °C: 907
vapor pressure (25°C), torr: Negligible
solubility in water, mg/L: ZnO, 1.6 at 29°C; $ZnCl_2$, 4.32 x 10^6 at 25°C
common oxidation states: Always +2 in aqueous solution

Probable Fate

photolysis: Not important
oxidation: ZnS precipitates under reducing conditions; most redox conditions do not affect Zn directly, but affect materials which sorb Zn
hydrolysis: $Zn(OH)_2$ and ZnO precipitate after formation by hydrolysis
volatilization: Not important
sorption: Dominant fate of Zn is sorption by hydrous metal oxides, clay minerals, and organic materials
biological processes: Strongly bioaccumulated in all organisms and biotransformed to many zinc-containing enzymes.
other reactions/interactions: Not important

Precipitation/Coagulation Properties: Not available

INDUSTRIAL OCCURRENCE OF ZINC[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	60	5,300	1,700	0	45	6.4
Textile mills	NA	7,900	190[d]	0.00080	0.29	0.34
Explosives manufacture	ND	1,400	550	0	0.19	0.0024
Timber products processing	120	78,000	480[e]	0	22	0.041
Petroleum refining	24	760	250[d]	0	23	1.4
Paint and ink formulation	BDL	900,000	44,000	0	2.0	0.07
Gum and wood chemicals	50	38,000	7,000	0.063	53	11
Rubber processing	NA	770	300	6×10^{-5}	0.26	0.0099
Pulp, paper, and paperboard mills	2	66	18	0	NA	0.54
Auto and other laundries	ND	10,000	1,800	0.0016	2.5	0.38
Porcelain enameling	78	650,000	5,700	0.0037	2.3	0.46
Pharmaceutical manufacuring	ND	500	120	0	0.83	0.11
Ore mining and dressing	<20	40	<27	0	NA	<1.0
Steam electric power generating (condenser cooling system)	<5	780	127	0.0067	0.14	0.030
Steam electric power generating (water treatment)	20	NA	11,000	6.7×10^{-5}	660	1.7
Steam electric power generating (boiler or steam generator blowdown)	10	50	20	8.4×10^{-8}	0.28	0.003
Steam electric power generating (maintenance cleaning)	50	900,000	136,000	0.00014	2,600	41
Steam electric power generating (ash handling)	BDL	1,200	350	6.7×10^{-7}	34	8.0
Steam electric power generating (air pollution control devices)	10	590	300	0.00029	17	1.1
Steam electric power generating (drainage)	4	23,000	540	0.0046	0.20	0.011
Inorganic chemicals manufacturing	NA	35,000[f]	NA	0	2,200	438
Coil coating	12	340,000	11,000	0.55	20	5.3
Foundries	ND	350,000	49,000	0	328	328
Leather tanning and finishing	96	2,600	540	0	NA	0.81
Iron and steel manufacturing	NA	160,000	7,000	0	NA	1,300
Nonferrous metals manufacturing	ND	2×10^{-8}	190,000	0	NA	10,070

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF ZINC[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	60	73	61	0	1.6	0.23
Textile mills	NA	38,000	200[d]	0.00084	5.8	0.36
Timber products processing	47	41,000	250[d]	0	11	0.021
Petroleum refining	<10	1,000	<70[d]	0	6.5	0.41
Paint and ink formulation	BDL	100,000	4,800	0	0.22	0.0077
Gum and wood chemicals	37	450	190	0.0017	1.4	0.31
Rubber processing	NA	2,300	170	3.4×10^{-5}	0.15	0.0056
Explosives manufacture	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	4	1,600	150	0	NA	4.5
Auto and other laundries	55	1,000	300	0.00027	0.42	0.063
Porcelain enameling	32	5,000	1,200	0.00077	0.49	0.096
Pharmaceutical manufacturing	ND	270	86	0	0.58	0.079
Ore mining and dressing	0.01	3,000	1.6	0	NA	0.060
Foundries	40	190,000	19,000	0	130	51
Iron and steel manufacturing	NA	36,000	1,700	0	NA	310
Nonferrous metals manufacturing	ND	100,000	10,400	0	NA	550
Coil coating	34	720	370	0.019	0.67	0.18
Leather tanning and finishing	49	170	91	0	NA	0.17

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ZINC[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	390	III.4.1
Gas flotation			11-22	27,000	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			>95->99	150	III.4.5
Gas flotation with chemical addition (polymer)			>38->60	120	III.4.5
Gas flotation with chemical addition (alum, polymer)			10[d]	2,300[d]	III.4.5
Filtration			39->99	940	III.4.6
Sedimentation			71->99	2,600	III.4.2
Sedimentation with chemical addition (alum, lime)			55->99	3,400	III.4.3
Sedimentation with chemical addition (lime, polymer)			84->99	410	III.4.3
Sedimentation with chemical addition (Fe^{2+}, lime)			>79->97	12	III.4.3
Sedimentation with chemical addition (sulfide)			>98->99	140	III.4.3
Sedimentation with chemical addition (polymer)			84-97	2,400	III.4.3
Sedimentation with chemical addition ($BaCl_2$)			65-80	30	III.4.3
Sedimentation with chemical addition (alum, polymer)			69-83	660	III.4.3
Sedimentation with chemical addition (alum)			69-83	3,800	III.4.3
Sedimentation with chemical addition (lime)			77->99	640	III.4.3
Aerated lagoons			55->99	180	III.5.3
Ultrafiltration			>78-98	8,600	III.4.7
Ozonation			32-96	260	III.6.14
Ion exchange			97[d]	400[d]	III.6.7
Activated sludge			35-92	200	III.5.1
Powdered activated carbon adsorption			0[d,e]	-[e]	III.6.2
Powdered activated carbon adsorption (with activated sludge)			58-98	110	III.6.2
Granular activated carbon adsorption			40->99	440	III.6.1
Reverse osmosis			83->99	530	III.6.9

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

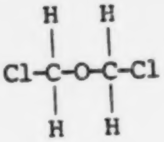
1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 963.

2. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 19-1 - 19-21.

3. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. B-59.

Compound: Bis(chloromethyl) ether

Formula:



$$\mathrm{Cl{-}\overset{H}{\underset{H}{C}}{-}O{-}\overset{H}{\underset{H}{C}}{-}Cl}$$

Alternate Names: BCME, Bis-CME,
sym-Dichloromethyl ether,
Oxybis(chloromethane)

CAS #: 542-88-1

Physical, Chemical, and Biological Properties [1]

mol. wt.: 115 m.p., °C: -41.5 b.p. (760 torr), °C: 104
vapor pressure (22°C), torr: 30
solubility in water, mg/L: 22,000
log octanol/water partition coefficients: -0.38
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Can occur, but cannot compete with hydrolysis in water
oxidation: Oxidation by hydroxyl radical can compete with hydrolysis in air but not in water
hydrolysis: Very rapidly hydrolyzed, independent of pH, decomposes to HCl and formaldehyde even in moist air
volatilization: Cannot compete with hydrolysis
sorption: Not important
biological processes: Not important
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF BIS(CHLOROMETHYL) ETHER[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF BIS(CHLOROMETHYL) ETHER[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BIS(CHLOROMETHYL) ETHER[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers
Gravity oil separation			NA	390	III.4.1
Activated sludge			>83[d]	>10[d]	III.5.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

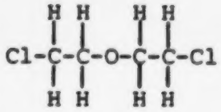
[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 64-1 - 64-5.

Compound: Bis(2-chloroethyl) ether   Formula:



$$\mathrm{Cl{-}\overset{H}{\underset{H}{C}}{-}\overset{H}{\underset{H}{C}}{-}O{-}\overset{H}{\underset{H}{C}}{-}\overset{H}{\underset{H}{C}}{-}Cl}$$

Alternate Names: 1,1'-Oxybis(2-chloroethane), Bis(β-chloroethyl)ether, Chlorex, 1-Chloro-2-(β-chloroethoxy) ethane

CAS #: 111-44-4

Physical, Chemical, and Biological Properties [1]

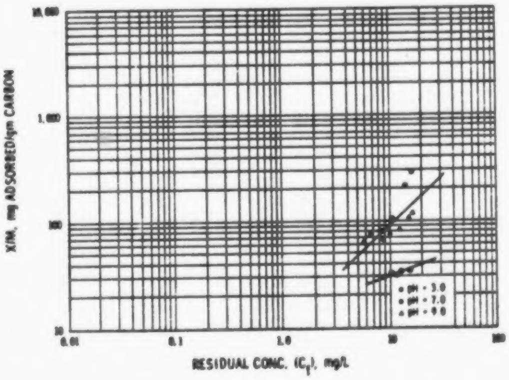
mol. wt.: 143.0   m.p., °C: -46.8   b.p. (760 torr), °C: 178
vapor pressure (20°C), torr: 0.71
solubility in water (25°C), mg/L: 10,200
log octanol/water partition coefficients: 1.58
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Direct photolysis is probably not important
oxidation: Photooxidation only in atmosphere
hydrolysis: Very slow, maybe significant, hydrolysis of carbon-chlorine bonds
volatilization: Importance unknown
sorption: Apparently unimportant
biological processes: No bioaccumulation noted; biodegradation not important under natural conditions
other reactions/interactions: Not important; principle fate uncertain

Carbon Adsorption Data [2]

pH: 3.0, 7.0, 9.0
type of carbon: Filtrasorb-300
adsorbability: 860 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF BIS(2-CHLOROETHYL) ETHER[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pharmaceutical manufacturing	ND	170	19	0	0.13	0.017
Foundries	ND	NA	4.5	0	0.030	0.012

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF BIS(2-CHLOROETHYL) ETHER[a,b]

	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pharmaceutical manufacturing	ND	110	14	0	0.10	0.013
Foundries	NA	8[d]	8[d]	0	0.054	0.0022

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BIS(2-CHLOROETHYL) ETHER[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Activated sludge	~100	<50	>47[d]	<10[d]	III.5.1
Powdered activated carbon adsorption	53	24,000	53[d]	44[d]	III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

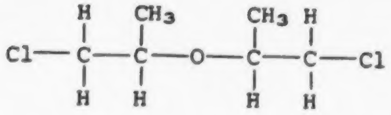
[d] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 65-1 - 65-7.

2. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Bis(2-chloroisopropyl) ether **Formula:**



$$\mathrm{Cl-\overset{H}{\underset{H}{C}}-\overset{CH_3}{\underset{H}{C}}-O-\overset{CH_3}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-Cl}$$

Alternate Names: Bis(2-chloro-1-methylethyl) ether, 2,2'-Oxybis(1-chloropropane), Dichlorodiisopropyl ether, 2,2'-Dichloroisopropyl ether

CAS #: 108-60-1

Physical, Chemical, and Biological Properties [1]

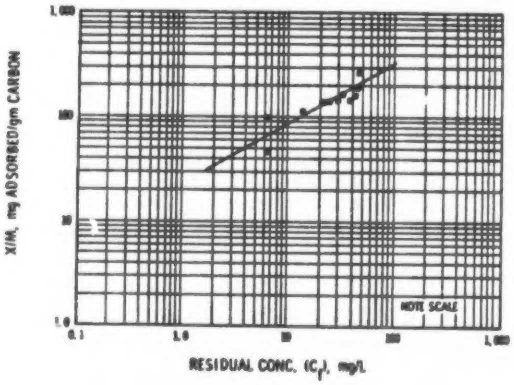
mol. wt.: 171.1 m.p., °C: -97 b.p. (760 torr), °C: 189
vapor pressure (20°C), torr: 0.85
solubility in water (temp. unknown), mg/L: 1,700
log octanol/water partition coefficients: 2.58
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Direct photolysis is probably not important
oxidation: Photooxidation in atmosphere can occur
hydrolysis: Slow hydrolysis of carbon-chlorine bond, may be important fate mechanism
volatilization: Importance unknown
sorption: Little data available, but adsorption on organic matter possible
biological processes: No data on bioaccumulation and biodegradation
other reactions/interactions: None of importance known; principle fate uncertain

Carbon Adsorption Data [2]

pH: 5.4
type of carbon: Filtrasorb-300
adsorbability: 375 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.4



INDUSTRIAL OCCURRENCE OF BIS(2-CHLOROISOPROPYL) ETHER[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pharmaceutical manufacturing	ND	ND	ND	–[b]	–[b]	–[b]
Foundries	3[d]	3[d]	3[d]	0	0.020	0.010

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF BIS(2-CHLOROISOPROPYL) ETHER[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pharmaceutical manufacturing	ND	ND	ND	-[d]	-[d]	-[d]

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BIS(2-CHLOROISOPROPYL) ETHER[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Activated sludge			~100	<50	III.5.1
Powdered activated carbon adsorption			87	6,200	III.6.2
Aerated lagoons			>0[d]	<2[d]	III.5.3

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

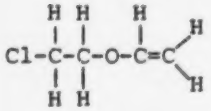
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 66-1 - 66-7.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 2-Chloroethyl vinyl ether

Formula:



Alternate Names: (2-Chloroethoxy) ethene,
Vinyl 2-chloroethyl ether

CAS #: 110-75-8

Physical, Chemical, and Biological Properties [1]

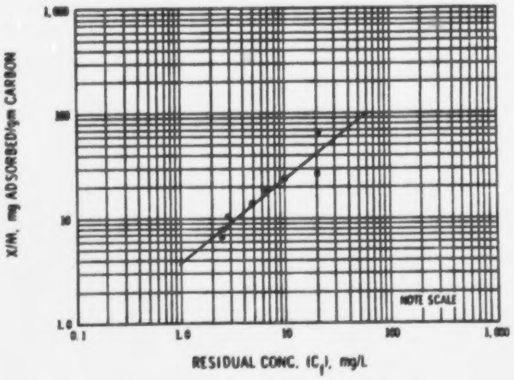
mol. wt.: 106.6 m.p., °C: -69.7 b.p. (760 torr), °C: 108
vapor pressure (20°C), torr: 26.75
solubility in water (temp. unknown), mg/L: 15,000
log octanol/water partition coefficients: 1.28
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Direct photolysis is probably not important
oxidation: Atmospheric photooxidation after volatilization principal fate of $ClCH_2CH_2OCHCH_2$
hydrolysis: Of minor importance if compound is adsorbed by clays or fulvic acids
volatilization: High vapor pressure indicates strong volatilization
sorption: Probably adsorbed by clays and humic materials
biological processes: Insufficient data to reach conclusion
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 2,300 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF 2-CHLOROETHYL VINYL ETHER[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF 2-CHLOROETHYL VINYL ETHER[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 2-CHLOROETHYL VINYL ETHER[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers
Activated sludge	~100	<50			III.5.1
Powdered activated carbon adsorption	93	2,300			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

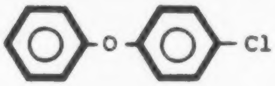
[c] Average and maximum removals reported.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 67-1 - 67-7.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 4-Chlorophenyl phenyl ether   Formula:



Alternate Names: 1-Chloro-4-phenoxybenzene,
ρ-Chlorophenyl phenyl ether,
4-Chlorodiphenyl ether,
4-Chlorophenyl ether

CAS #: 7005-72-3

Physical, Chemical, and Biological Properties [1]

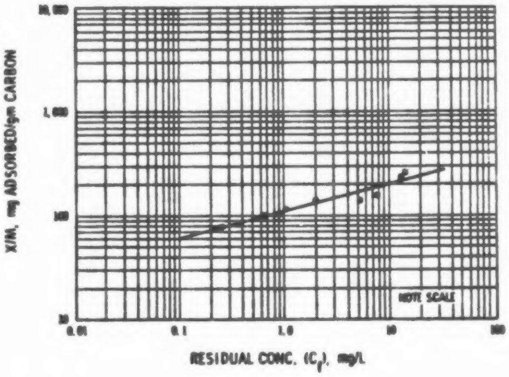
mol. wt.: 203.7   m.p., °C: -8   b.p. (760 torr), °C: 284
vapor pressure (25°C), torr: 0.0027
solubility in water (25°C), mg/L: 3.3
log octanol/water partition coefficients: 4.08
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Could be important if compound is adsorbed by humus containing sensitizers (polyfunctional aromatics)
oxidation: Not important
hydrolysis: Not important
volatilization: Although no data available, believed to be unimportant
sorption: Adsorption by humus certain; by clays probable
biological processes: Possible bioaccumulation; gradual biodegradation (t 1/2 ∿4 hours in activated sewage sludge)
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 81 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF 4-CHLOROPHENYL PHENYL ETHER[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	3.3	0.4	0	0.011	0.0015
Iron and steel manufacturing	NA	NA	210	0	NA	38

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF 4-CHLOROPHENYL PHENYL ETHER[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Indeterminate.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 4-CHLOROPHENYL PHENYL ETHER[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Activated sludge	36	3,200			III.5.1
Powdered activated carbon adsorption	98	260			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

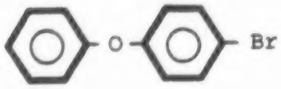
[c] Average and maximum removals reported.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 68-1 - 68-7.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 4-Bromophenyl phenyl ether   Formula:



Alternate Names: 1-Bromo-4-phenoxybenzene,
ρ-Bromophenyl phenyl ether,
4-Bromodiphenyl ether,
4-Bromophenyl ether

CAS #: 101-55-3

Physical, Chemical, and Biological Properties [1]

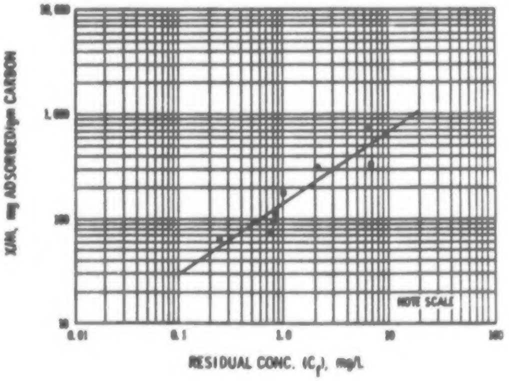
mol. wt.: 249.1   m.p., °C: 18.7   b.p. (760 torr), °C: 310
vapor pressure (20°C), torr: 0.0015
solubility in water (20°C), mg/L: No data found
log octanol/water partition coefficients: 4.28
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Could be important if adsorbed by sensitizer-containing humus
oxidation: Not important
hydrolysis: Not important
volatilization: Believed to be unimportant
sorption: Adsorption by humus certain; by clays probable
biological processes: Bioaccumulation possible; gradual biodegradation probable principle fate
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 62 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF 4-BROMOPHENYL PHENYL ETHER[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF 4-BROMOPHENYL PHENYL ETHER[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 4-BROMOPHENYL PHENYL ETHER[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Activated sludge	36	3,200	95[d]	18[d]	III.5.1
Powdered activated carbon adsorption	98	240			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

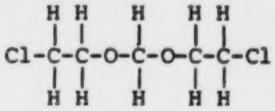
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 69-1 - 69-7.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Bis(2-chloroethoxy)methane

Formula:



$$Cl-\underset{H}{\overset{H}{C}}-\underset{H}{\overset{H}{C}}-O-\underset{H}{\overset{H}{C}}-O-\underset{H}{\overset{H}{C}}-\underset{H}{\overset{H}{C}}-Cl$$

Alternate Names: Dichlorodiethyl methylal,
Bis(β-chloroethyl) formal,
β,β-Dichlorodiethyl formal

CAS #: 111-91-1

Physical, Chemical, and Biological Properties [1]

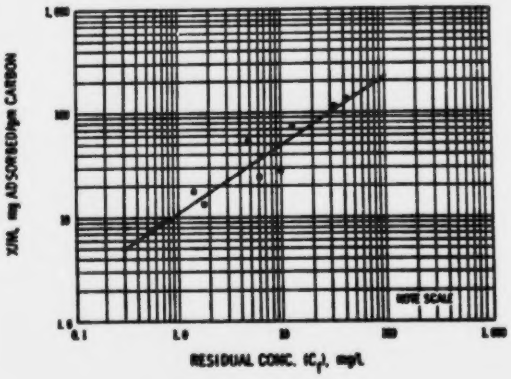
mol. wt.: 173.1 m.p., °C: -32.8 b.p. (760 torr), °C: 218
vapor pressure (20°C), torr: <0.1
solubility in water (temp. unknown), mg/L: 81,000
log octanol/water partition coefficients: 1.26
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Could possibly compete with hydrolysis
oxidation: Could occur (too slow to be important)
hydrolysis: Gradual hydrolysis of carbon-chlorine bond probable principle fate mechanism
volatilization: Not important
sorption: Possible importance as catalyst for hydrolysis
biological processes: Not enough data to draw conclusion
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH; 5.3
type of carbon: Filtrasorb-300
adsorbability: 820 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF BIS (2-CHLOROETHOXY)METHANE[a,b,]

	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	50	11	0	0.29	0.041
Foundries	ND	NA	20	0	0.13	0.05

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF BIS(2-CHLOROETHOXY)METHANE[a]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<5.7	0	0.15	0.021
Auto and other laundries	NA	11[d]	11[d]	1.0×10^{-5}	0.015	0.0023

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BIS(2-CHLOROETHOXY)METHANE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Aerated lagoons	0	NA	>60[d]	<10[d]	III.5.3
Powdered activated carbon adsorption	97	1,800			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

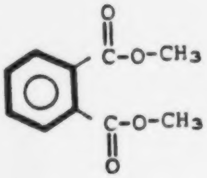
[d] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 70-1 - 70-7.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Dimethyl phthalate **Formula**:



Alternate Names: DMP, 1,2-Benzenedicarboxylic acid, Dimethyl ester, Phthalic acid dimethyl ester, Methyl phthalate

CAS #: 131-11-3

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 194.2   m.p., °C: 0   b.p. (760 torr), °C: 282
vapor pressure (20°C), torr: <0.01
solubility in water (32°C), mg/L: 4,300
log octanol/water partition coefficients: 2.12
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

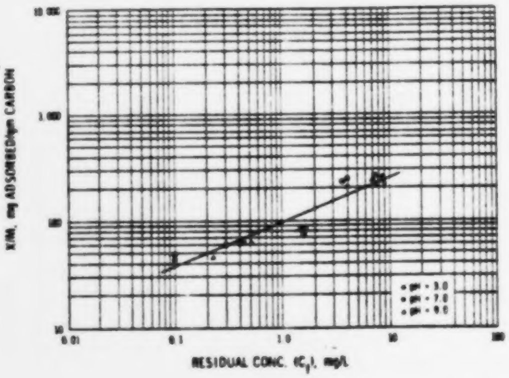
photolysis: No direct photolysis; indirect photolysis too slow to be important
oxidation: Not important
hydrolysis*: Too slow to be important under natural conditions
volatilization: Possible, but not important
sorption*: Sorption onto particles and Biota and complexation with humic substances principal transport mechanism
biological processes*: Bioaccumulation, biodegradation, and biotransformation by many organisms (including humans) are very important fates
other reactions/interactions: Not important

---

*Inferred from data on phthalate esters as a group.

Carbon Adsorption Data [3]

pH: 3.0, 7.0, 9.0
type of carbon: Filtrasorb-300
adsorbability: 93 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF DIMETHYL PHTHALATE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.5	0	0.013	0.0019
Textile mills	NA	14	12[d]	5×10^{-5}	0.35	0.22
Petroleum refining	NA	NA	NA	NA	NA	NA
Rubber processing	NA	14	5	1×10^{-6}	0.0043	0.00016
Auto and other laundries	ND	≤5	1	9×10^{-7}	0.001	0.00021
Coil coating	ND	14	10	0.0005	0.018	0.005
Foundries	ND	2,200	72	0	0.19	0.48
Leather tanning and finishing	NA	NA	17	0	NA	0.026
Nonferrous metals manufacturing	ND	56	4.7	0	NA	0.25
Iron and steel manufacturing	NA	20	16	0	NA	2.9

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF DIMETHYL PHTHALATE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	ND	ND	–[d]	–[d]	–[d]
Textile mills	NA	1.0[e]	1.0[e]	4.2×10^{-6}	0.029	0.0018
Petroleum refining	NA	NA	3[f]	0	0.28	0.017
Rubber processing	NA	14	7.5	1.5×10^{-6}	0.0064	0.00025
Foundries	10	320	79	0	0.53	0.21
Iron and steel manufacturing	10	<10	0	NA	1.8	
Nonferrous metals manufacturing	ND	1,300	67	0	NA	3.6

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] One sample.

[f] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DIMETHYL PHTHALATE[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., μg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., μg/L	Volume III references, Section numbers
Filtration			>98[d]	<0.03[d]	III.4.6
Sedimentation			49->99	42	III.4.2
Aerated lagoons			25[d]	6[d]	III.5.3
Activated sludge	~100	<50	58->99	19	III.5.1
Powdered activated carbon adsorption	99	100			III.6.2
Reverse osmosis			30-41	110	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

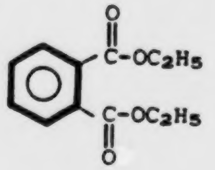
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 94-1 - 94-28.

2. Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976.

3. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Diethyl phthalate

Formula:



Alternate Names: DEP, Ethyl phthalate, 1,2-Benzendicarboxylic acid, Diethyl ether

CAS #: 84-66-2

Physical, Chemical, and Biological Properties [1]

mol. wt.: 222.2   m.p., °C: -40.5   b.p. (760 torr), °C: 298
vapor pressure (70°C), torr: 0.05
solubility in water (32°C), mg/L: 1,000
log octanol/water partition coefficients: 3.22
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

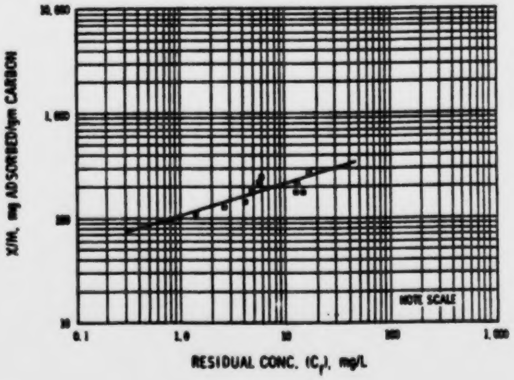
photolysis: No direct photolysis; indirect photolysis too slow to be important
oxidation: Not important
hydrolysis*: No data, but believed to be too slow to be important under natural conditions
volatilization: Very little data, but volatilization is not considered as important as sorption
sorption*: Adsorption onto solids and particles and complexation with humic material (fulvic acid) are the principal transport for DEP
biological processes*: Bioaccumulation, biodegradation, and biotransformation by many organisms (including humans) are very important fates
other reactions/interactions: Not important

---

*Inferred from data on phthalate esters as a group.

Carbon Adsorption Data [2]

pH: 5.4
type of carbon used: Filtrasorb-300
adsorbability: 82 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.4



INDUSTRIAL OCCURRENCE OF DIETHYL PHTHALATE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<3.7	0	0.098	0.023
Textile mills	NA	86	6.0[e]	2.5×10^{-5}	0.17	0.011
Petroleum refining	NA	12[d]	12[d]	0	1.1	0.070
Pulp, paper and paperboard mills	<1	29	<15	0	NA	0.45
Auto and other laundries	ND	25	4	3.6×10^{-6}	0.0056	0.00084
Pharmaceutical manufacturing	ND	31	8	0	0.054	0.0074
Ore mining and dressing	ND	9.6	2.9	0	NA	0.11
Steam electric power generating (condenser cooling system)	10	11	11	0.00058	0.012	0.026
Steam electric power generating (ash handling)	NA	NA	NA	NA	NA	NA
Coil coating	ND	600	53	0.0097	0.095	0.025
Foundries	ND	730	58	0	0.39	0.16
Iron and steel manufacturing	NA	10	7	0	NA	1.3
Nonferrous metals manufacturing	ND	83	4.7	0	NA	0.25

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Median, not average.

INDUSTRIAL OCCURRENCE OF DIETHYL PHTHALATE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<5.7	0	0.15	0.021
Textile mills	NA	9.4	15[d]	6.3×10^{-6}	0.043	0.0027
Petroleum refining	<10	30	20[d]	0	1.9	0.12
Pulp, paper and paperboard mills	<1	69	<24	0	NA	0.72
Pharmaceutical manufacturing	ND	ND	ND	-[e]	-[e]	-[e]
Foundries	10	11,000	910	0	6.1	2.5
Iron and steel manufacturing	NA	14	10	0	NA	1.8
Nonferrous metals manufacturing	ND	82	6	0	NA	0.32

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DIETHYL PHTHALATE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gravity oil separation			NA	12[d]	III.4.1
Gas flotation			>17[d]	ND	III.4.4
Filtration			37->99	2,000	III.4.6
Sedimentation			33->99	24	III.4.2
Sedimentation with chemical addition			>99[d]	<10[d]	III.4.3
Sedimentation with chemical addition			>98[d]	<0.03[d]	III.4.3
Aerated lagoons			0[d,e]	-[e]	III.5.3
Trickling filters			0[d,e]	-[e]	III.5.2
Activated sludge	~100	<50	58->99	6	III.5.1
Granular activated carbon adsorption			0[e]	-[e]	III.6.1
Powdered activated carbon adsorption	95	860			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

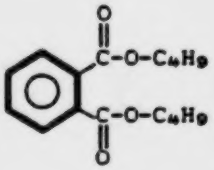
[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 94-1 - 94-28.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Di-n-butyl phthalate **Formula**:



Alternate Names: DBP, *o*-Benzenedicarboxylic acid, Dibutyl ester, Benzene-*o*-dicarboxylic acid, Di-n-butyl ester, n-Butyl phthalate, Dibutyl phthalate

CAS #: 84-74-2

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 278.3 m.p., °C: -35 b.p. (760 torr), °C: 340
vapor pressure (115°C), torr: 0.1
solubility in water (25°C), mg/L: 13
log octanol/water partition coefficients: ~5.2 (exact value unknown due to molecular folding)
Henry's law constant: Not available
biodegradability: Aerobic degradation in freshwater hydrosoil; 53% after 24-hr incubation, 98% after 5 days incubation

Probable Fate [1]

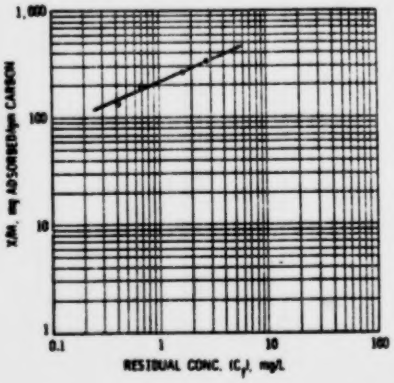
photolysis: No direct photolysis; indirect photolysis too slow to be environmentally important
oxidation: Not important
hydrolysis*: Hydrolysis (only in surface waters) believed to be too slow to be important
volatilization: Not likely to be an important transport process
sorption*: Sorption onto particulates and complexation with organics are dominant transport processes
biological processes*: Bioaccumulated in many organisms; biodegraded rapidly in natural soil; some biotransformation; all biological processes important fates
other reactions/interactions: Not important

---

*Inferred from data on phthalate esters as a group.

Carbon Adsorption Data [3]

pH: 3.0
type of carbon: Filtrasorb-300
adsorbability: 42 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF DI-n-BUTYL PHTHALATE^{a,b}

Industry	Raw wastewater					
	Concentration, µg/L			Loading,^{c} kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	3.3	<10	<8.8	0	0.23	0.033
Textile mills	NA	67	16^{e}	6.7×10^{-5}	0.46	0.029
Petroleum refining	NA	1.3^{d}	1.3^{d}	0	0.12	0.0075
Paint and ink formulation	ND	69,000	4,100	0	0.19	0.0066
Rubber processing	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills^{d}	NA	<1	<1	0	NA	0.030
Auto and other laundries	ND	820	29	2.6×10^{-5}	0.041	0.0061
Pharmaceutical manufacturing	ND	90	10	0	0.068	0.0092
Ore mining and dressing	ND	140	45	0	NA	1.7
Steam electric power generating (condenser cooling system)	<10	48	18	0.00095	0.020	0.0043
Steam electric power generating (ash handling)	7	48	32	0.00061	3.1	0.70
Coil coating	ND	160	10	0.0005	0.018	0.0048
Foundries	ND	5,400	160	0	1.1	0.43
Iron and steel manufacturing	NA	520	33	0	NA	5.9
Nonferrous metals manufacturing	ND	390	25	0	NA	1.3

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Median, not average.

INDUSTRIAL OCCURRENCE OF DI-n-BUTYL PHTHALATE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	<3.3	10	<7.7	0	0.20	0.029
Textile mills	NA	3.6[d]	3.6[d]	1.5×10^{-5}	0.10	0.0065
Petroleum refining	0.7	10	5.4[e]	0	0.50	0.031
Paint and ink formulation	ND	1,300	160	0	0.0074	0.00026
Rubber processing	NA	36[d]	36[d]	7.2×10^{-6}	0.031	0.0012
Pulp, paper and paperboard mills	<1	8	<3	0	NA	NA
Auto and other laundries	0.9	290	76	6.8×10^{-5}	0.11	0.016
Pharmaceutical manufacturing	ND	12	0.86	0	0.0058	0.00079
Foundries	1.0	9,300	710	0	4.8	1.9
Iron and steel manufacturing	NA	420	35	0	NA	6.3
Noferrous metals manufacturing	ND	79	15	0	NA	0.80

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DI-n-BUTYL PHTHALATE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	1.3[d]	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			39-79	150	III.4.5
Gas flotation with chemical addition (polymer)			>61->99	<5	III.4.5
Gas flotation with chemical addition (alum, polymer)			0[d,e]	-[e]	III.4.5
Filtration			16->99	910	III.4.6
Sedimentation			40->99	42	III.4.2
Sedimentation with chemical addition (alum, lime)			>99[d]	<10[d]	III.4.3
Sedimentation with chemical addition (lime, polymer)			99[d]	1[d]	III.4.3
Sedimentation with chemical addition (polymer)			50->99	<6.4	III.4.3
Sedimentation with chemical addition (alum, polymer)			>78->99	<8.5	III.4.3
Sedimentation with chemical addition (alum)			0[e]	-[e]	III.4.3
Aerated lagoons			0[d,e]	-[e]	III.5.3
Ozonation			77[d]	2.7[d]	III.6.14
Activated sludge	~100	<50	60->99	<9	III.5.1
Granular activated carbon adsorption			62->99	1.3	III.6.1
Reverse osmosis			59-83	0.9	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

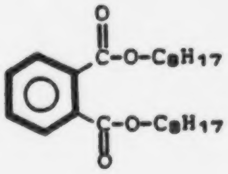
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 94-1 - 94-28.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. pp. 222, 223.

3. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Di-n-octyl phthalate

Formula:



Alternate Names: DOP, *o*-Benzenedicarboxylic acid, Dioctyl ester, n-Dioctyl phthalate, Octyl phthalate, Dioctyl-*o*-benzenedicarboxylate

CAS #: 117-84-0

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 391.0 m.p., °C: -25 b.p. (4 torr), °C: 220
vapor pressure (150°C), torr: <0.2
solubility in water (25°C), mg/L: 3
log octanol/water partition coefficients: ∿9.2 (exact value unknown because of molecular folding)
Henry's law constant: Not available
biodegradability: Aerobic degradation in fresh water hydrosoil; 50% after 14 days incubation

Probable Fate [1]

photolysis: No direct photolysis; indirect photolysis too slow to be important
oxidation: Not important
hydrolysis*: Hydrolysis only in surface waters but too slow to be important
volatilization: Not likely to be an important transport process
sorption*: Adsorption onto solids and particles and complexation with organics are important transport processes
biological processes*: Bioaccumulation by many organisms, biodegradation, and metabolization are all important fates
other reactions/interactions: Not important

---

*Inferred from data on phthalate esters as a group.

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF DI-n-OCTYL PHTHALATE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.4	0	0.011	0.0015
Auto and other laundries	ND	410	24	2.2×10^{-5}	0.034	0.005
Coil coating	ND	180	16	0.00080	0.0077	0.029
Foundries	ND	NA	710	0	4.8	1.9
Iron and steel manufacturing	NA	120	13	0	NA	2.3
Nonferrous metals manufacturing	ND	95	8.4	0	NA	0.44

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF DI-n-OCTYL PHTHALATE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1	0	0.026	0.0038
Auto and other laundries	ND	4	2	2.0×10^{-6}	0.0028	0.00042
Foundries	NA	73[d]	73[d]	0	0.49	0.02
Iron and steel manufacturing	NA	490	39	0	NA	7.0
Nonferrous metals manufacturing	ND	189	12	0	NA	0.64

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DI-n-OCTYL PHTHALATE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gas flotation with chemical addition (calcium chloride, polymer)			78[d]	33[d]	III.4.5
Gas flotation with chemical addition (polymer)			61[d]	11[d]	III.4.5
Gas flotation with chemical addition (alum, polymer)			0[d,e]	-[e]	III.4.5
Filtration			>73->96	<1.5	III.4.6
Sedimentation			>49->99	<35	III.4.2
Sedimentation with chemical addition (alum, polymer)			92	5	III.4.3
Activated sludge	94	300	50->99	2,500	III.5.1
Granular activated carbon adsorption			76-96	110	III.6.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

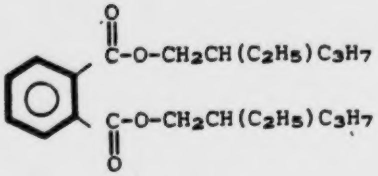
[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 94-1 - 94-28.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. pp. 279-281.

Compound: Bis(2-ethylhexyl) phthalate **Formula:**



Alternate Names: DEHP, Di(2-ethylhexyl) phthalate, Bis(2-ethylhexyl) ester phthalic acid, Di(2-ethylhexyl) orthophthalate, Di-sec-octyl phthalate, 2-Ethylhexyl phthalate, 1,2-Benzene dicarboxylic acid, Bis(2-ethylhexyl) ester

CAS #: 117-81-7

Physical, Chemical, and Biological Properties [1]

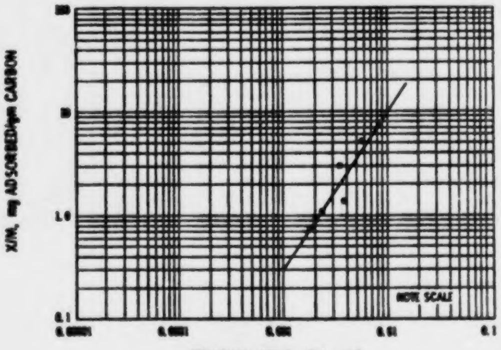
mol. wt.: 391.0 m.p., °C: -50 b.p. (760 torr), °C: 387
vapor pressure (20°C), torr: 2×10^{-7}
solubility in water (25°C), mg/L: 0.4
log octanol/water partition coefficients: ∿8.73 (exact value unknown because of molecular folding)
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: No direct photolysis; indirect photolysis too slow to be important
oxidation: Not important
hydrolysis: Too slow to be important (half-life of several years)
volatilization: Not a likely transport process
sorption: Sorption onto particulates and biota and complexation with humic materials are most important transport processes
biological processes: Bioaccumulation and metabolization by many organisms, and biodegradation are all very important fates
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 5.3
type of carbon used: Filtrasorb-300
adsorbability: Not available



INDUSTRIAL OCCURRENCE OF BIS(2-ETHYLHEXYL) PHTHALATE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	50	11	0	0.29	0.041
Textile mills	NA	860	26[e]	0.00011	0.75	0.047
Explosives manufacture	NA	72[d]	72[d]	0	0.025	0.00031
Timber products processing	BDL	1,500	280[f]	0	13	0.024
Petroleum refining	180	700	300[e]	0	28	1.7
Paint and ink formulation	ND	87,000	7,300	0	0.33	0.012
Gum and wood chemicals	NA	NA	NA	NA	NA	NA
Rubber processing	NA	530	170	3.4×10^{-5}	0.15	0.0056
Pulp, paper, paperboad mills	<1	66	<16	0	NA	0.48
Auto and other laundries	ND	18,000	1,000	0.0009	1.4	0.21
Pharmaceutical manufacturing	ND	170	38	0	0.26	0.035
Ore mining and dressing	0.004	50	12	0	NA	0.44
Steam electric power generating (condenser cooling system)	<10	36	27	0.0014	0.030	0.0065
Steam electric power generating (water treatment)	NA	NA	<1	6.1×10^{-9}	<0.06	0.00015
Steam electric power generating (ash handling)	17	310	22	0.00040	2.2	0.48
Inorganic chemicals manufacturing	NA	120	NA	0	7.5	1.5
Coil coating	ND	1,100	75	0.0038	0.13	0.036
Foundries	ND	817,000	21,000	0	141	57
Leather tanning and finishing	NA	NA	25	0	NA	0.038
Iron and steel manufacturing	NA	10,000	451	0	NA	81
Nonferrous metals manufacturing	ND	7,000	237	0	NA	13

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Median, not average.

[f] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF BIS(2-ETHYLHEXYL) PHTHALATE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<5.7	0	0.15	0.021
Textile mills	NA	230	18[d]	7.6×10^{-5}	0.52	0.032
Timber products processing	BDL	350	9[d]	0	0.41	0.00077
Petroleum refining	190	2,000	600[d]	0	56	3.5
Paint and ink formulation	ND	160	22	0	0.0010	3.5×10^{-5}
Gum and wood chemicals	NA	1,900[e]	1,900[e]	0.017	14	31
Rubber processing	NA	430	100	2.0×10^{-5}	0.086	0.0033
Explosives manufacture	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	<1	294	<30	0	NA	0.90
Auto and other laundries	ND	96	37	3.3×10^{-5}	0.052	0.0078
Pharmaceutical manufacturing	ND	380	47	0	0.32	0.043
Foundries	2	16,000	1,600	0	11	4.3
Iron and steel manufacturing	ND	11,000	680	0	NA	120
Nonferrous metals manufacturing	ND	1,200	110	0	NA	5.8
Leather tanning and finishing	ND	34	11	0	NA	0.017

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BIS(2-ETHYLHEXYL) PHTHALATE^{a,b}

Treatment process^{a}	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,^{c} %	Average achievable conc., µg/L	Removal range,^{c} %	Average achievable conc., µg/L	
Gravity oil separation			NA	270	III.4.1
Gas flotation			0^{d}	$-^{d}$	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			72-82	610	III.4.5
Gas flotation with chemical addition (polymer)			51-92	60	III.4.5
Gas flotation with chemical addition (alum, polymer)			25^{e}	90^{e}	III.4.5
Filtration			44-98	1,200	III.4.6
Sedimentation			33->99	24	III.4.2
Sedimentation with chemical addition (alum, lime)			$0^{d,e}$	$-^{d}$	III.4.3
Sedimentation with chemical addition (lime, polymer)			49-9[illegible]	22	III.4.3
Sedimentation with chemical addition (polymer)			>48->97	<10	III.4.3
Sedimentation with chemical addition ($BaCl_2$)			48-95	9	III.4.3
Sedimentation with chemical addition (alum, polymer)			78^{e}	67^{e}	III.4.3
Sedimentation with chemical addition (alum)			0^{d}	$-^{d}$	III.4.3
Tertiary polishing lagoons			>58-72	<11	III.5.3
Aerated lagoons			70-96	<11	III.5.3
Trickling filters			83^{e}	6^{e}	III.5.2
Ozonation			0^{d}	$-^{d}$	III.6.14
Activated sludge	95	250	37->99	64	III.5.1
Powdered activated carbon adsorption	83	1800	$>97^{e}$	$<10^{e}$	III.6.2
Granular activated carbon adsorption			18-66	65	III.6.1
Reverse osmosis			51-96	21	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Actual data indicate negative removal.

[e] Only one data point.

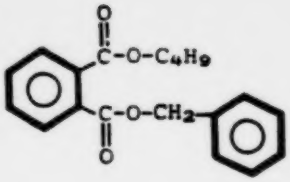
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 94-1 - 94-28.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Butyl benzyl phthalate

Formula:



Alternate Names: BBP, Benzyl butyl phthalate

CAS #: 85-68-7

Physical, Chemical, and Biological Properties [1]

mol. wt.: 312.0 m.p., °C: -35 b.p. (760 torr), °C: 377
vapor pressure (25°C), torr: Not available
solubility in water (temperature unknown), mg/L: 2.9
log octanol/water partition coefficients: ∿5.8 (exact value unknown because of molecular folding)
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

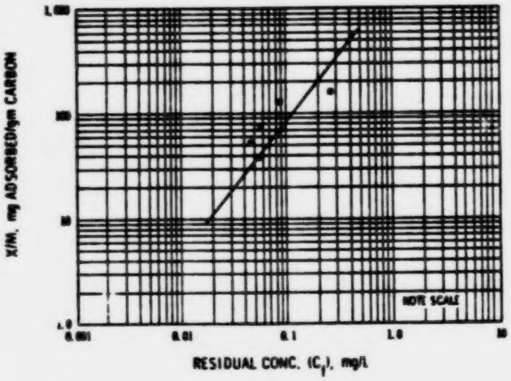
photolysis: Direct photolysis improbable; indirect photolysis too slow to be important
oxidation: Could occur, but probably cannot compete with biodegradation
hydrolysis*: Too slow to be important
volatilization: Not a likely transport process
sorption*: Sorption onto particulates and complexation with organic substances are dominant transport processes
biological processes*: Bioaccumulated and metabolized by many organisms; biodegraded under natural conditions
other reactions/interactions: Not important

---

*Based on data for phthalate esters as a group.

Carbon Adsorption Data [2]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: Not available



INDUSTRIAL OCCURRENCE OF BUTYL BENZYL PHTHALATE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<3.3	0	0.087	0.012
Textile mills	NA	73	42[d]	1.6×10^{-5}	1.2	0.076
Pulp, paper, and paperboad mills	2	100	51	0	NA	1.5
Auto and other laundries	ND	1,500	34	3.1×10^{-5}	0.048	0.0071
Pharmaceutical manufacturing	ND	360	33	0	0.22	0.030
Ore mining and dressing	ND	66	22	0	NA	0.81
Steam electric power generating (condenser cooling system)	NA	NA	10	0.00053	0.0024	0.011
Steam electric power generating (ash handling)	NA	NA	NA	NA	NA	NA
Coil coating	ND	300	57	0.0029	0.10	0.027
Foundries	ND	180	29	0	0.078	0.19
Iron and steel manufacturing	NA	340	34	0	NA	6.1
Nonferrous metals manufacturing	ND	98	11	0	NA	0.58

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF BUTYL BENZYL PHTHALATE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<3.3	0	0.087	0.012
Textile mills	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	3	11	7	0	NA	0.21
Auto and other laundries	4	11	7.7	7×10^{-6}	0.011	0.0016
Pharmaceutical manufacturing	ND	ND	ND	-[d]	-[d]	-[d]
Foundries	2	49	23	0	0.15	0.062
Iron and steel manufacturing	NA	990	680	0	NA	120
Nonferrous metals manufacturing	ND	75	7.0	0	NA	0.37

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detecton limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BUTYL BENZYL PHTHALATE[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Gas flotation			$>99^d$	ND	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			$>99^d$	$<0.03^d$	III.4.5
Gas flotation with chemical addition (polymer)			$>99^d$	$<0.03^d$	III.4.5
Gas flotation with chemical addition (alum, polymer)			$0^{d,e}$	$-^e$	III.4.5
Filtration			76->99	2.2	III.4.6
Sedimentation			>48->99	<11	III.4.2
Sedimentation with chemical addition (lime, polymer)			$>99^d$	$<10^d$	III.4.3
Sedimentation with chemical addition (alum, polymer)			54	36	III.4.3
Aerated lagoons			$0^{d,e}$	$-^e$	III.5.3
Trickling filters			25	6	III.5.2
Ozonation			$>97^d$	$<0.03^d$	III.6.14
Activated sludge			$0^{d,e}$	$-^e$	III.5.1
Granular activated carbon adsorption	~100	<50	>83->99	5.7	III.6.1
Powdered activated carbon adsorption	94	26			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

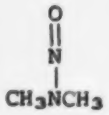
[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 94-1 - 94-28.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: N-nitrosodimethylamine Formula:



$$\begin{array}{c}\mathrm{O}\\ \|\\ \mathrm{N}\\ |\\ \mathrm{CH_3NCH_3}\end{array}$$

Alternate Names: N-methyl-N-nitrosomethanamine,
Dimethylnitrosamine

CAS #: 62-75-9

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 74.08 m.p., °C: Not available b.p. (760 torr), °C: 151-153
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Miscible
log octanol/water partition coefficients: 0.06
Henry's law constant: Not available
biodegradability: Aerobic degradation in continuous activated sludge unit; 2 ppm concentration reduced to below 0.1 ppm

Probable Fate [1]

photolysis: Slow photolysis in aqueous solution (but fast in atmosphere) is the principal fate
oxidation: Not important
hydrolysis: Does not occur under natural conditions
volatilization: Much too slow to be important
sorption: Does not occur
biological processes: No bioaccumulation; resistant to biodegradation under natural conditions
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF N-NITROSODIMETHYLAMINE[a,b]

	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF N-NITROSODIMETHYLAMINE[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR N-NITROSODIMETHYLAMINE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers
Aerated lagoons			67[d]	1[d]	III.5.3

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

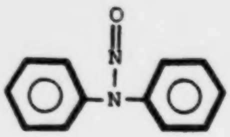
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 99-1 - 99-7.

2. Fochtman, E. G., and W. Eisenberg. Treatability of Carcinogenic and other Hazardous Organic Compounds. Illinois Institute of Technology Research Institute, Chicago, Illinois. 58 pp.

Compound: Nitrosodiphenylamine

Formula:



Alternate Names: N-nitroso-N-phenyl benzamine,
Diphenylnitrosoamine

CAS #: 86-30-6

Physical, Chemical, and Biological Properties [1]

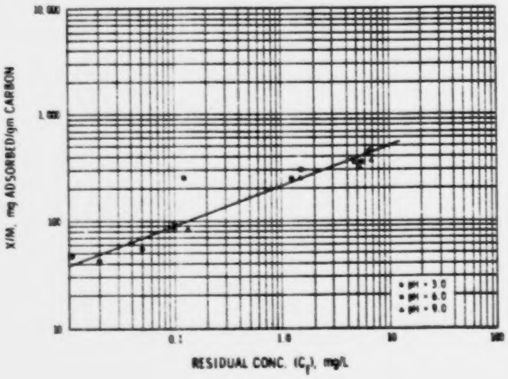
mol. wt.: 198.2 m.p., °C: 66.5 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Not available
log octanol/water partition coefficients: 2.57
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Photolysis may be an important fate process
oxidation: Not important
hydrolysis: Does not occur under natural conditions
volatilization: Not important
sorption: Probably adsorbed by organic materials but exact fate unknown
biological processes: Potential for bioaccumulation, biodegradation, and biotransformation, but quantized data unavailable
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 3.0, 7.0, 9.0
type of carbon: Filtrasorb-300
adsorbability: 42 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF N-NITROSODIPHENYLAMINE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	30	3.8	0	0.10	0.014
Textile mills	NA	72	15[d]	6.3×10^{-5}	0.43	0.027
Rubber processing	NA	53	35	7.0×10^{-6}	0.030	0.0011
Auto and other laundries	ND	1,800	95	8.6×10^{-5}	0.13	0.020
Pharmaceutical manufacturing	ND	12	30	0	0.020	0.0028
Foundries	ND	1,400	250	0	1.7	0.68
Leather tanning and finishing	ND	NA	36	0	NA	0.054

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF N-NITROSODIPHENYLAMINE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	ND	ND	$-^d$	$-^d$	$-^d$
Textile mills	NA	NA	NA	NA	NA	NA
Rubber processing	NA	NA	NA	NA	NA	NA
Auto and other laundries	NA	620[e]	620[e]	0.00056	0.87	0.13
Pharmaceutical manufacturing	ND	ND	ND	$-^d$	$-^d$	$-^d$
Foundries	NA	190[e]	190[e]	0	1.3	0.51

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR N-NITROSODIPHENYLAMINE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gas flotation with chemical addition (calcium chloride, polymer)			66[d]	620[d]	III.4.5
Filtration			0[d,e]	-[e]	III.4.6
Sedimentation			>77[d]	<10[d]	III.4.2
Activated sludge	~100	<50	84->99	<0.8	III.5.1
Granular activated carbon adsorption			>82[d]	<0.07[d]	III.6.1
Powdered activated carbon adsorption	~100	10			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

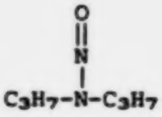
[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 100-1 - 100-5.

2. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: N-nitroso-di-n-propylamine **Formula:**



$C_3H_7-N(-N=O)-C_3H_7$

Alternate Names: N-nitroso-N-propyl-1-propanamine,
Di-n-propylnitrosoamine

CAS #: 621-64-7

Physical, Chemical, and Biological Properties [1]

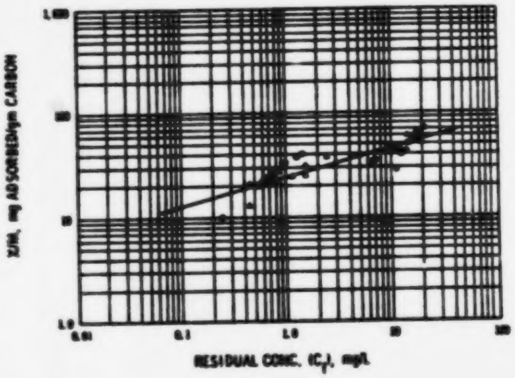
mol. wt.: 130.2 m.p., °C: Not available b.p. (760 torr), °C: 205
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: 9,900
log octanol/water partition coefficients: 1.31
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Photolysis is slow but is the principal fate of the compound
oxidation: Not important
hydrolysis: Not important
volatilization: No loss to volatilization reported
sorption: No specific data but moderate adsorption by organic matter is possible
biological processes: Not important
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 3.0, 5.3, 9.0
type of carbon: Filtrasorb-300
adsorbability: 370 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L (data at each pH pooled)



INDUSTRIAL OCCURRENCE OF N-NITROSODI-n-PROPYLAMINE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	NA	NA	NA	NA	NA
Foundries	ND	210	60	0	0.40	0.16

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF N-NITROSODI-n-PROPYLAMINE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	19	10	4.2×10^{-5}	0.89	0.018
Foundries	NA	34[d]	34[d]	0	0.23	0.0071

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR N-NITROSO-DI-n-PROPYLAMINE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Activated sludge	50	2500	0[d]	-[d]	III.5.1
Powdered activated carbon adsorption	99	260			

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Actual data indicate negative removal.

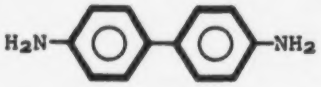
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 101-1 - 101-7.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Benzidine

Formula:



Alternate Names: 4,4'-Diaminodiphenyl,
4,4'-Biphenyldiamine,
(1,1'-Biphenyl)-4,4'-diamine

CAS #: 92-87-5

Physical, Chemical, and Biological Properties [1]

mol. wt.: 184.2 m.p., °C: 129 b.p. (760 torr), °C: 402
vapor pressure (25°C), torr: Not available
solubility in water (12°C), mg/L: 400
log octanol/water partition coefficients: 1.81
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Possible but actual significance uncertain
oxidation: Oxidation by metal cations very fast; also, reactions with oxygen and/or hyperoxy radical are very important
hydrolysis: Not important
volatilization: Not important
sorption: Very rapid adsorption by clay minerals
biological processes: No bioaccumulation; only slight biodegradation
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF BENZIDINE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Leather tanning and finishing	NA	NA	4	0	NA	0.0060
Nonferrous metals manufacturing	ND	6	1.2	0	NA	0.064

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF BENZIDINE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries	NA	<20[d]	<20[d]	0	0.13	0.054

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BENZIDINE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Aerated lagoons			41[d]	7[d]	III.5.3
Activated sludge			0[d,e]	-[e]	III.5.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

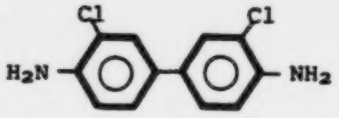
[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume III, Ethers, Phthalate Esters, and Nitrosamines. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 102-1 - 102-9.

Compound: 3,3'-Dichlorobenzidine **Formula**:



Alternate Names: 3,3'-Dichloro-4,4'-diamino-(1,1'-biphenyl)

CAS #: 91-94-1

Physical, Chemical, and Biological Properties [1]

mol. wt.: 253.1 m.p., °C: 132 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Not available
log octanol/water partition coefficients: 3.02
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

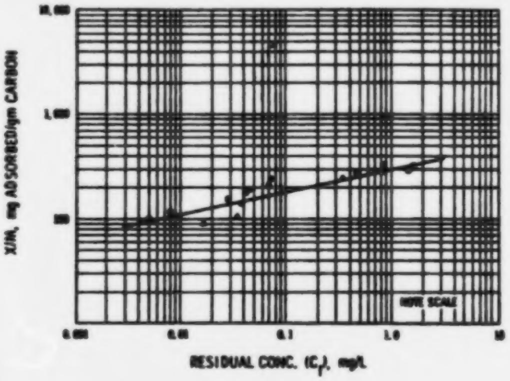
photolysis*: Possible, but exact importance unknown
oxidation*: Oxidized (especially by metal cations) like benzidine but not quite as easily
hydrolysis: Not important
volatilization*: Not important
sorption*: Adsorption by clay minerals, possibly most important transport process
biological processes: No data available
other reactions/interactions: Not important

---

*Based on data for unsubstituted benzidine.

Carbon Adsorption Data [2]

pH: 7.2, 9.1
type of carbon: Filtrasorb-300
adsorbability: 30 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L (data at each pH pooled)



INDUSTRIAL OCCURRENCE OF 3,3'-DICHLOROBENZIDINE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	NA	ND	-[d]	-[d]	-[d]
Nonferrous metals manufacturing	ND	2	0.3	0	NA	0.016

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

INDUSTRIAL OCCURRENCE OF 3,3'-DICHLOROBENZIDINE[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<0.4	0	0.011	0.0015

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 3,3'-DICHLOROBENZIDINE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Powdered activated carbon adsorption	~100	5			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

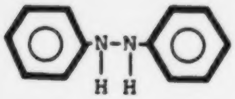
[c] Average and maximum removals reported.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 103-1 - 103-10.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 1,2-Diphenylhydrazine Formula:



Alternate Names: Hydrazobenzene, N,N'-bianiline

CAS #: 122-66-7

Physical, Chemical, and Biological Properties [1, 2, 3]

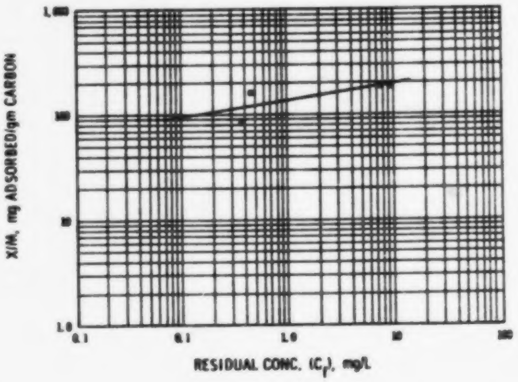
mol. wt.: 184.2 m.p., °C: 131 b.p. (760 torr), °C: Decomposes near melting point
vapor pressure (25°C), torr: Not available
solubility in water (temp. unknown), mg/L: 221
log octanol/water partition coefficients: 3.03
Henry's law constant: Not available
biodegradability: No information for 1,2-Diphenylhydrazine; 1,1-Diphenylhydrazine reduced from 2 ppm to nondetectable levels during 7-day static biological test using activated sludge

Probable Fate [1]

photolysis: Slow photoreduction to aniline possibly leads to destruction of compound
oxidation: Reversible oxidation to azobenzene occurs; further oxidation unknown if any
hydrolysis: Only possible in bisulfite wastes of a paper mill or coal mine
volatilization: Not important
sorption: Sorption onto particulates is the main transport process for the compound
biological processes: No data, but bioaccumulation possible
other reactions/interactions: Intramolecular rearrangement to form benzidine occurs in acidic solution

Carbon Adsorption Data [3]

pH: 7.5
type of carbon: Filtrasorb-300
adsorbability: 67 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 7.5



INDUSTRIAL OCCURRENCE OF 1,2-DIPHENYLHYDRAZINE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.4	0	0.011	0.0015
Textile mills	NA	22[d]	22[d]	9.2×10^{-5}	0.63	0.040
Pharmaceutical manufacturing	ND	10	2	0	0.014	0.0018
Iron and steel manufacturing	NA	NA	NA	NA	NA	NA

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF 1,2-DIPHENYLHYDRAZINE[a,b]

	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<0.6	0	0.016	0.0023
Textile mills	NA	NA	NA	NA	NA	NA
Auto and other laundries	NA	30[d]	30[d]	2.7×10^{-5}	0.042	0.0063
Pharmaceutical manufacturing	ND	ND	ND	-[e]	-[e]	-[e]
Iron and steel manufacturing	NA	370	120	0	NA	22
Foundries	<20	180	73	0	0.49	0.20

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,2-DIPHENYLHYDRAZINE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Aerated lagoons			0[d,e]	-[e]	III.5.3
Activated sludge	80	1,000	0[d,e]	-[e]	III.5.1
Powdered activated carbon adsorption	96	390			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

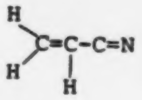
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 104-1 - 104-9.

2. Fochtman, E. G., and W. Eisenberg. Treatability of Carcinogenic and other Hazardous Organic Compounds. Illinois Institute of Technology Research Institute, Chicago, Illinois. 58 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Acrylonitrile

Formula:



Alternate Names: Vinyl cyanide,
Cyanoethylene, propenonitrile

CAS #: 107-13-1

Physical, Chemical, and Biological Properties [1]

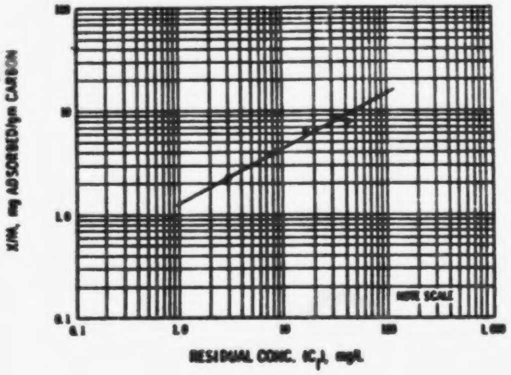
mol. wt.: 53.06 m.p., °C: -82 b.p. (760 torr), °C: 78.5
vapor pressure (22.8°C), torr: 100
solubility in water (20°C), mg/L: 73,500
log octanol/water partition coefficients: -0.14
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: No direct photolysis; indirect photolysis with photosensitizer probable in atmosphere
oxidation: Free radical oxidation too slow to be important
hydrolysis: Not important
volatilization: High vapor pressure indicates volatilization is the major transport process
sorption: Possible adsorption onto clay particles
biological processes: Little, if any bioaccumulation; biodegradation very important fate
other reactions/interactions: Conversion to CNS^- ion occurs with basic catalysts

Carbon Adsorption Data [2]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 6,400 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF ACRYLONITRILE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	1,600[d]	1,600[d]	0.0067	46	2.9
Rubber processing	NA	23,000[d]	23,000[d]	0.0046	20	0.76
Iron and steel manufacturing	NA	21,000	6,900	0	NA	1,200

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF ACRYLONITRILE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	400[d]	400[d]	0.0014	0.10	0.014
Rubber processing	NA	23,000[d]	23,000[d]	0.0046	20	0.76
Iron and steel manufacturing	NA	NA	3,000	0	NA	540
Foundries	NA	23[d]	23[d]	0	0.15	0.062

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ACRYLONITRILE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	30[d]	III.4.1
Activated sludge	~100	<50			III.5.1
Powdered activated carbon adsorption	94	3,000			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

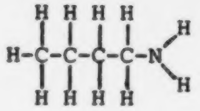
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 105-1 - 105-8.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Butylamine

Formula:



Alternate Names: 1-Aminobutane

CAS #: 109-73-9

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 73.14 m.p., °C: -49.1 b.p. (760 torr), °C: 77.8
vapor pressure (20°C), torr: 72
solubility in water (25°C), mg/L: Not available
log octanol/water partition coefficients: Not available
Henry's law constant: Not available
biodegradability: Degradation by Aerobacter at 3°C of 200 mg/L concentration was 100% in 7 hours

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not adsorbed by activated carbon

INDUSTRIAL OCCURRENCE OF BUTYLAMINE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF BUTYLAMINE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BUTYLAMINE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

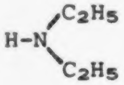
REFERENCES

1. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 144.

Compound: Diethylamine

Formula:



$H{-}N(C_2H_5)_2$

Alternate Names: None

CAS #: 109-89-7

Physical, Chemical, and Biological Properties [1,2]

mol. wt.: 73.14   m.p., °C: -48 to -50   b.p. (760 torr), °C: 56.3
vapor pressure (20°C), torr: 200
solubility in water (14°C), mg/L: 815,000
log octanol/water partition coefficients: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

Date: 6/23/80

INDUSTRIAL OCCURRENCE OF DIETHYLAMINE[a,b]

	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF DIETHYLAMINE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DIETHYLAMINE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

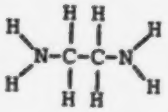
REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 242.

2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-106.

Compound: Ethylenediamine

Formula:



Alternate Names: Diaminoethane,
1,2-Ethanediamine,
1,2-Diaminoethane

CAS #: 107-15-3

Physical, Chemical, and Biological Properties [1-4]

mol. wt.: 60.11   m.p., °C: 8.5   b.p. (760 torr), °C: 116
vapor pressure (21°C), torr: 10
solubility in water (25°C), mg/L: Freely soluble, forms hydrate
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 98% ethylenediamine removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 9.8 mg COD/g dry innoculum/hr

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not adsorbed by activated carbon

INDUSTRIAL OCCURRENCE OF ETHYLENEDIAMINE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ETHYLENEDIAMINE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ETHYLENEDIAMINE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977.

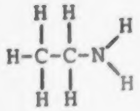
2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 317.

3. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

4. Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976.

Compound: Monoethylamine

Formula:



$CH_3CH_2NH_2$

Alternate Names: Ethylamine, Aminoethane

CAS #: 75-04-7

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 45.09   m.p., °C: -81   b.p. (760 torr), °C: 16.6
vapor pressure (20°C), torr: 910
solubility in water (25°C), mg/L: Miscible
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF MONOETHYLAMINE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF MONOETHYLAMINE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR MONOETHYLAMINE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

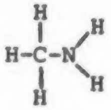
REFERENCES

1. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 305.

Compound: Monomethylamine

Formula:



Alternate Names: Methylamine, Aminomethane,
Carbinamine, Mercurialin,
Methanamine

CAS #: 74-89-5

Physical, Chemical, and Biological Properties [1]

mol. wt.: 31.06 m.p., °C: -95.3 b.p. (760 torr), °C: -6.3
vapor pressure (21°C), torr: 2,160
solubility in water (25°C), mg/L: At 760 torr, 1 volume of water dissolves 959 volumes of gas
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF MONOMETHYLAMINE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF MONOMETHYLAMINE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR MONOMETHYLAMINE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

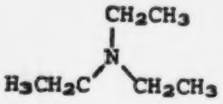
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part I, pp. 50, 51.

Compound: Triethylamine

Formula:



Alternate Names: None

CAS #: 121-44-8

Physical, Chemical, and Biological Properties [1]

mol. wt.: 101.2   m.p., °C: -115   b.p. (760 torr), °C: 90
vapor pressure (25°C), torr: 50
solubility in water (20°C), mg/L: 15,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Degradation by Aerobacter at 30°C of 200 mg/L concentration was 100% in 11 hours

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

Date: 6/23/80

INDUSTRIAL OCCURRENCE OF TRIETHYLAMINE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: **No data available. Data will be supplied in future revisions.**

INDUSTRIAL OCCURRENCE OF TRIETHYLAMINE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR TRIETHYLAMINE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

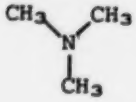
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 616.

Compound: Trimethylamine

Formula:



Alternate Names: None

CAS #: 75-50-3

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 59.11 m.p., °C: -117 to -124 b.p. (760 torr), °C: 3.5
vapor pressure (20°C), torr: 1,440
solubility in water (19°C), mg/L: 410,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF TRIMETHYLAMINE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF TRIMETHYLAMINE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR TRIMETHYLAMINE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

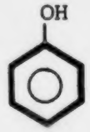
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 619.

2. McGraw Hill, Inc. Lange's Handbook of Chemistry, 12th Edition. New York, New York, 1979. p. 7-380.

Compound: Phenol **Formula:**



Alternate Names: Carbolic acid, Hydroxybenzene,
Phenyl hydroxide, Phenic acid,
Phenyl hydrate

CAS #: 108-95-2

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 94.11 m.p., °C: 40.9 b.p. (760 torr), °C: 182
vapor pressure (20°C), torr: 0.529*
solubility in water (25°C), mg/L: 67,000
log octanol/water partition coefficient: 1.46
Henry's law constant: 1.3×10^{-6} atmos. m^3 $mole^{-1}$
biodegradability: 98% phenol removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 80 mg COD/g dry innoculum/hr

---

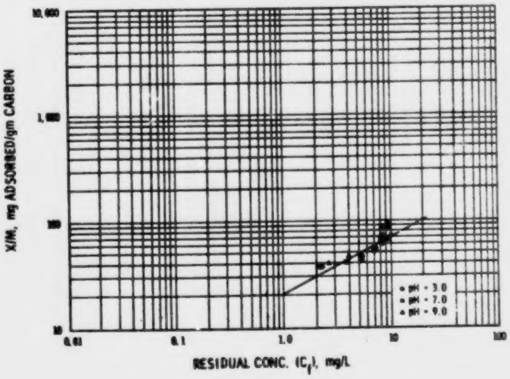
*Vapor pressure of phenol as a supercooled liquid.

Probable Fate [1]

photolysis: Photooxidation of volatized phenol and photolysis of phenolic anion may both take place at moderate rates
oxidation: Metal-catalyzed oxidation may take place in highly aerated waters
hydrolysis: Not important
volatilization: Very little, if any, volatilization of phenol occurs
sorption: Not important
biological processes: No bioaccumulation, but very extensive biodegradation in natural waters
other reactions/interactions: Chlorination of water may produce chlorophenols

Carbon Adsorption Data [43]

pH: 3.0, 7.0, 9.0
type of carbon: Filtrasorb-300
adsorbability: 430 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF PHENOL[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10,000	<2,100	0	56	7.9
Textile mills	NA	4,900	55[d]	0.00023	1.6	0.099
Explosives manufacture	15	70	40	0	0.014	0.00017
Timber products processing	BDL	87,000	8,000[e]	0	370	0.69
Petroleum refining	13	4,900	>245[d]	0	23	1.4
Paint and ink formulation	ND	3,800	560	0	0.026	0.00090
Gum and wood chemicals	130	23,000	5,600	0.050	42	9.2
Rubber processing	NA	440	230	4.6×10^{-5}	0.20	0.0076
Pulp, paper and paperboard mills	<1	58	<7	0	NA	0.21
Auto and other laundries	ND	840	28	2.5×10^{-5}	0.039	0.0059
Pharmaceutical manufacturing	ND	17,000	1,400	0	9.5	1.3
Ore mining and dressing	66	210	140	0	NA	5.2
Steam electric power generators (condenser cooling system)	5	20	7.5	0.0004	8.2×10^{-3}	0.0018
Steam electric power generators (water treatment)	NA	NA	20	1×10^{-7}	1.2	0.003
Steam electric power generators (ash handling)	6	40	25	0.00048	2.5	0.55
Inorganic chemicals manufacturing	NA	160[f]	NA	0	10	2
Coil coating	NA	16[g]	16[g]	0.0008	0.0029	0.0077
Foundries	ND	26,000	1,500	0	10	4.1
Leather tanning and finishing	10	NA	2,500	0	NA	3.8
Iron and steel manufacturing	NA	670,000	17,000	0	NA	3,100
Nonferrous metals manufacturing	ND	70	12	0	NA	0.64

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segments.

[g] One sample.

INDUSTRIAL OCCURRENCE OF PHENOL[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10,000	<2,000	0	53	7.6
Textile mills	NA	50	14[d]	5.9×10^{-5}	0.40	0.025
Timber products processing	BDL	16,000	15[d]	0	0.69	0.0012
Petroleum refining	NA	NA	59[d]	0	5.5	0.34
Paint and ink formulation	ND	1,200	140	0	0.0064	0.00022
Gum and wood chemicals	NA	850[e]	850[e]	0.0076	6.4	1.4
Rubber processing	NA	12,000	3,000	0.00060	2.6	0.099
Explosives manufacture	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	<1	72	<11	0	NA	0.33
Auto and other laundries	ND	120	38	3.4×10^{-5}	0.053	0.0080
Pharmaceutical manufacturing	ND	17,000	1,700	0	12	1.6
Ore mining and dressing	<0.01	<0.01	<0.01	0	NA	<0.00037
Foundries	<10	34,000	6,100	0	41	16
Iron and steel manufacturing	NA	53,000	900	0	NA	160
Leather tanning and finishing	ND	1,400	320	0	NA	0.48

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR PHENOL[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	2,200	III.4.1
Gas flotation			26-51	1,200	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			46-80	87	III.4.5
Gas flotation with chemical addition (polymer)			36-72	18	III.4.5
Gas flotation with chemical addition (alum, polymer)			0[d,e]	-[e]	III.4.5
Filtration			26->93	3,400	III.4.6
Sedimentation			40->99	<21	III.4.2
Sedimentation with chemical addition (alum, lime)			48-96	25	III.4.3
Sedimentation with chemical addition (lime, polymer)			18->37	<10	III.4.3
Sedimentation with chemical addition (polymer)			14-29	37	III.4.3
Sedimentation with chemical addition (alum, polymer)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (alum)			>80->90	<5	III.4.3
Aerated lagoons			>55->99	<14	III.5.3
Trickling filters			0[d,e]	-[e]	III.5.2
Solvent extraction			65->99	2,200,000	III.5.6
Activated sludge			82->99	79	III.5.1
Powdered activated carbon adsorption	~100	<50	>83->85	95,000	III.6.2
Granular activated carbon adsorption	78	2,200	>60->96	0.7	III.6.1
Reverse osmosis			33-80	2.9	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

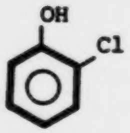
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 83-1 - 83-11.

2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: 2-Chlorophenol **Formula:**



Alternate Names: *o*-Chlorophenol

CAS #: 95-57-8

Physical, Chemical, and Biological Properties [1, 2]

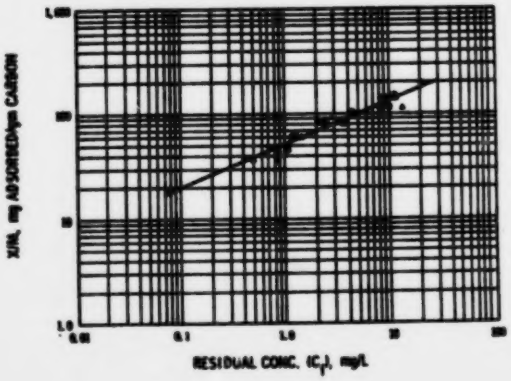
mol. wt.: 128.6 m.p., °C: 8.4 b.p. (760 torr), °C: 176
vapor pressure (20°C), torr: 2.2 (calculated)
solubility in water (20°C), mg/L: 28,500
log octanol/water partition coefficient: 2.17
Henry's law constant: Not available
biodegradability: 96% 2-chlorophenol removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 25 mg COD/g dry innoculum/hr

Probable Fate [1]

photolysis: Photolysis occurs in aqueous alkali, but environmental importance is unknown
oxidation: Could occur, but probably cannot compete with biodegradation
hydrolysis: Not important
volatilization: Probably occurs, but not fast enough to be important
sorption: Slight potential for adsorption by lipophilic materials
biological processes: No bioaccumulation; much more resistant to biodegradation than phenol
other reactions/interactions: Chlorination of water could further chlorinate 2-chlorophenol

Carbon Adsorption Data [3]

pH: 3.0, 5.8, 9.0
type of carbon: Filtrasorb-300
adsorbability: 180 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L (data at each pH pooled)



INDUSTRIAL OCCURRENCE OF 2-CHLOROPHENOL[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	86	12	0	0.32	0.045
Textile mills	NA	78[d]	78[d]	0.00033	2.2	0.14
Timber products processing	BDL	42	15[e]	0	0.69	0.0013
Pulp, paper, paperboard mills	NA	NA	NA	NA	NA	NA
Auto and other laundries	ND	1	1	9×10^{-7}	0.0014	0.00021
Pharmaceutical manufacturing	ND	22	2.4	0	0.016	0.0022
Steam electric power generators (water treatment)	NA	NA	27[f]	2×10^{-7}	1.6	0.004
Foundries	ND	210	53	0	0.35	0.14
Iron and steel manufacturing	NA	36,000	1,400	0	NA	250

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample

[e] Median, not average.

[f] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF 2-CHLOROPHENOL[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Textile mills	NA	5.9[e]	5.9[e]	2.5×10^{-5}	0.17	0.011
Timber products processing	BDL	4	BDL	-[d]	-[d]	-[d]
Pulp, paper and paperboard mills	NA	9[e]	9[e]	0	NA	0.27
Auto and other laundries	NA	2[e]	2[e]	1.8×10^{-6}	0.0028	0.00042
Pharmaceutical manufacturing	ND	55	6.	0	NA	0.0055
Foundries	8	40	22	0	0.15	0.059
Iron and steel manufacturing	NA	NA	11	0	NA	2.0

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 2-CHLOROPHENOL[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	 Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	 Average achievable conc., μg/L	Volume III references, Section numbers
Gravity oil separation			NA	33[d]	III.4.1
Gas flotation with chemical addition (polymer)			0[d,e]	-[e]	III.4.5
Sedimentation			44->88	<10	III.4.2
Sedimentation with chemical addition (lime, polymer)			0[d]	<5[d]	III.4.3
Activated sludge	~100	<50	46-92	5.5	III.5.1
Powdered activated carbon adsorption	97	500	81[d]	190,000[d]	III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

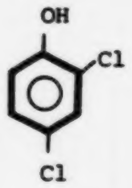
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 84-1 - 84-8.

2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 2,4-Dichlorophenol

Formula:



Alternate Names: 2,4-DCP

CAS #: 120-83-2

Physical, Chemical, and Biological Properties [1, 2]

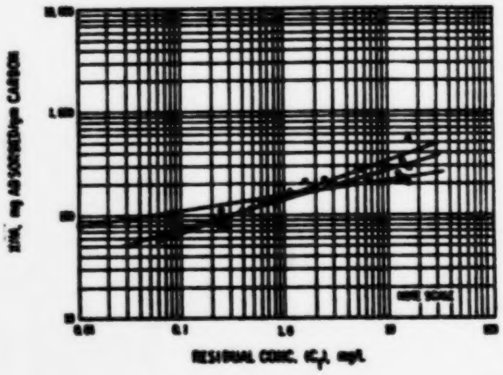
mol. wt.: 163.0 m.p., °C: 45 b.p. (760 torr), °C: 210
vapor pressure (20°C), torr: 0.12 (calculated)
solubility in water (20°C), mg/L: 4,500
log octanol/water partition coefficient: 2.75
Henry's law constant: Not available
biodegradability: 98% 2,4-dichlorophenol removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 10 mg COD/g dry innoculum/hr

Probable Fate [1]

photolysis: Photolysis possible, but cannot compete with microbial biodegradation
oxidation: Any oxidation which occurs is too slow to be important
hydrolysis: Not important
volatilization: No data, but not expected to be important
sorption: Sorption will not remove significant amounts of 2,4-Dichlorophenol
biological processes: Rapid microbial degradation is the principal fate of 2,4-DCP
other reactions/interactions: Chlorination of water may produce further chlorination of 2,4-DCP

Carbon Adsorption Data [3]

pH: 3.0, 5.3, 9.0
type of carbon: Filtrasorb-300
adsorbability: 57 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF 2,4-DICHLOROPHENOL[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	41	26[e]	0.00011	0.75	0.047
Pulp, paper and paperboard mills	NA	2d	2[d]	0	NA	0.060
Auto and other laundries	ND	≤10	2	1.8×10^{-6}	0.0028	0.0042
Pharmaceutical manufacturing	ND	5	1	0	0.0068	0.00092
Steam electric power generating (condenser cooling system)	NA	NA	NA	NA	NA	NA
Steam electric power generating (water treatment)	NA	NA	240[f]	1.5×10^{-6}	14	0.036
Steam electric power generating (ash handling)	NA	NA	83[f]	1.8	8.1	0.0016
Leather tanning and finishing	ND	NA	16	0	NA	0.024
Iron and steel manufacturing	NA	NA	35	0	NA	6.3

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF 2,4-DICHLOROPHENOL[a,b]

	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	<1	27	<7	0	NA	0.81
Auto and other laundries	NA	2[d]	2[d]	1.8×10^{-6}	0.0028	0.00042
Pharmaceutical manufacturing	ND	4.0	0.8	0	0.0054	0.00074
Foundries	<10	220	50	0	0.34	0.14
Iron and steel manufacturing	NA	NA	11	0	NA	2.0

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 2,4-DICHLOROPHENOL[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gas flotation with chemical addition (polymer)			$0^{d,e}$	$-^{e}$	III.4.5
Filtration			$0^{d,e}$	$-^{e}$	III.4.6
Sedimentation			33-98	29	III.4.2
Activated sludge	~100	<50	>25->50	<7	III.5.1
Powdered activated carbon adsorption	~100	10			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

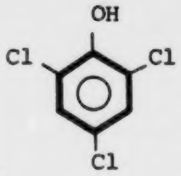
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 85-1 - 85-8.

2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 2,4,6-Trichlorophenol **Formula:**



Alternate Names: None

CAS #: 88-06-2

Physical, Chemical, and Biological Properties [1, 2]

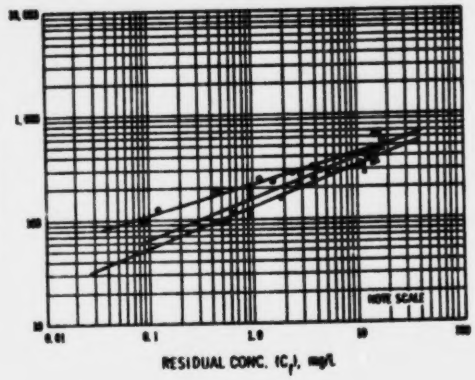
mol. wt.: 197.4 m.p., °C: 68 b.p. (760 torr), °C: 244
vapor pressure (76.5°C), torr: 1.0
solubility in water (25°C), mg/L: 800
log octanol/water partition coefficient: 3.38
Henry's law constant: Not available
biodegradability: 100% degradation of 200 mg/L solution by Pseudomonas at 30°C in 120 hr

Probable Fate [1]

photolysis: Reported in experiments, but environmental significance unknown
oxidation: Too slow to be important
hydrolysis: Not important
volatilization: Not important
sorption: High potential for sorption by organic materials; rate unknown
biological processes: Biodegradation very important, but exact rate uncertain due to variations between data
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 3.0, 6.0, 9.0
type of carbon: Filtrasorb-300
adsorbability: 58 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 6.0



INDUSTRIAL OCCURRENCE OF 2,4,6-TRICHLOROPHENOL[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	27	20[d]	8.4×10^{-5}	0.58	0.036
Timber products processing	BDL	530	250[d]	0	11	0.022
Rubber processing	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	<1	5	<3	0	NA	0.09
Auto and other laundries	NA	NA	NA	NA	NA	NA
Pharmaceutical manufacturing	ND	7	1.4	0	0.0095	0.0013
Steam electric power generating (condenser cooling system)	NA	NA	30	0.0016	0.033	0.0072
Leather tanning and finishing	ND	25,000	3,000	0	NA	5.0
Foundries	ND	350	67	0	0.45	0.18
Iron and steel manufacturing	NA	NA	39	0	NA	7

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF 2,4,6-TRICHLOROPHENOL[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	19[d]	19[d]	8×10^{-5}	0.55	0.034
Timber products processing	BDL	5[d]	BDL[d]	-[e]	-[e]	-[e]
Rubber processing	NA	14,000[d]	14,000[d]	0.0028	12	0.46
Pulp, paper and paperboard mills	<1	72	<18	0	NA	0.54
Pharmaceutical manufacturing	ND	6	0.6	5×10^{-7}	0.0041	0.00055
Foundries	2	600	110	0	0.74	0.30
Iron and steel manufacturing	NA	NA	11	0	NA	2.0
Leather tanning and finishing	ND	4,300	730	0	NA	1.1

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Mean pollutant concentration below detection limit.

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gas flotation with chemical addition (calcium chloride, polymer)			0[d,e]	-[e]	III.4.5
Filtration			80[d]	69[d]	III.4.6
Sedimentation			0[e]	-[e]	III.4.2
Aerated lagoons			>99[d]	<10[d]	III.5.3
Trickling filters			0[d,e]	-[e]	III.5.2
Activated sludge	~100	<50	36-98	450	III.5.1
Powdered activated carbon adsorption	~100	90			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

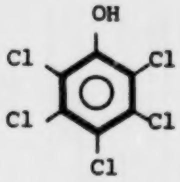
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 86-1 - 86-8.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 612.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Pentachlorophenol

Formula:



Alternate Names: PCP, Chlorophen, Pentachlorol

CAS #: 87-86-5

Physical, Chemical, and Biological Properties [1, 2]

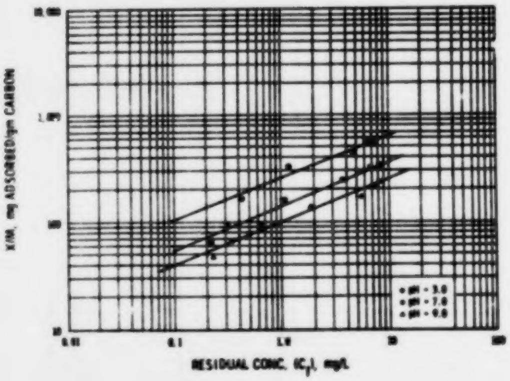
mol. wt.: 266.4 m.p., °C: 190 b.p. (760 torr), °C: 310
vapor pressure (20°C), torr: 0.00011 (calculated)
solubility in water (20°C), mg/L: 14
log octanol/water partition coefficient: 5.01
Henry's law constant: Not available
biodegradability: Decomposition rate in soil suspension, >72 days for complete dissapearance

Probable Fate [1]

photolysis: Forms a variety of products; very important fate
oxidation: Can occur, but relatively unimportant
hydrolysis: Not important
volatilization: Not important
sorption: Sorption by organic materials provides storage and transport process
biological processes: Strongly bioaccumulated by many organisms; biodegraded gradually by microbes
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 3.0, 7.0, 9.0
type of carbon: Filtrasorb-300
adsorbability: 62 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF PENTACHLOROPHENOL[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND[d]	ND[d]	ND[d]	BDL	BDL	BDL
Textile mills	NA	940	52	0.00022	1.5	0.094
Timber products processing	90	310,000	13,000[e]	0	600	1.1
Paint and ink formulation	ND	27,000	3,300	0	0.15	0.0053
Rubber processing	NA	31	17	3×10^{-6}	0.015	0.00056
Pulp, paper and paperboard mills	<1	9	<4	0	NA	0.12
Auto and other laundries	ND	9	3	2.7×10^{-6}	0.0042	0.00063
Pharmaceutical manufacturing	ND	62	4.4	0	0.030	4.04
Steam electric power generating (ash handling)	NA	NA	51	0.00097	5.0	1.1
Inorganic chemicals manufacturing	NA	NA	NA	NA	NA	NA
Foundries	ND	1,600	120	0	0.80	0.32
Leather tanning and finishing	ND	NA	1,700	0	NA	1.1×10^{-6}
Nonferrous metals manufacturing	ND	17	1.5	0	NA	0.079
Iron and steel manufacturing	NA	NA	76	0	NA	14

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] One sample.

[e] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF PENTACHLOROPHENOL[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.7	0	0.018	0.0026
Textile mills	NA	15	12[d]	5.0×10^{-5}	0.029	0.024
Timber products processing	32	130,000	910[d]	0	42	0.078
Paint and ink formulation	ND	490	120	0	0.0055	0.00019
Rubber processing	NA	10[e]	10[e]	2.0×10^{-6}	0.0086	0.00033
Pulp, paper and paperboard mills	<1	200	<25	0	NA	0.75
Auto and other laundries	10	58	34	3.1×10^{-5}	0.0476	0.0071
Pharmaceutical manufacturing	ND	ND	ND	ND	ND	ND
Foundries	12	140	49	0	0.33	0.13
Iron and steel manufacturing	NA	NA	10	0	NA	1.8
Leather tanning and finishng	ND	3,100	570	0	NA	0.86

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR PENTACHLOROPHENOL[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gravity oil separation			NA	330	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			0[d,e]	-[e]	III.4.5
Gas flotation with chemical addition (polymer)			9-19	19	III.4.5
Filtration			29->87	7.5	III.4.6
Sedimentation			55[d]	24[d]	III.4.2
Sedimentation with chemical addition (alum, polymer)			>96[d]	<0.4[d]	III.4.3
Aerated lagoons			>71[d]	<10[d]	III.5.3
Trickling filters			0[d,e]	-[e]	III.5.2
Activated sludge	~100	<50	70->99	240	III.5.1
Granular activated carbon adsorption			63->97	13	III.6.1
Powdered activated carbon adsorption	98	240			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

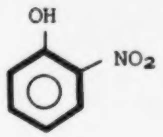
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 87-1 - 87-12.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 511.

3. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: 2-Nitrophenol

Formula:



Alternate Names: *o*-Nitrophenol, 2-Hydroxynitrobenzene

CAS #: 88-75-5

Physical, Chemical, and Biological Properties [1, 2]

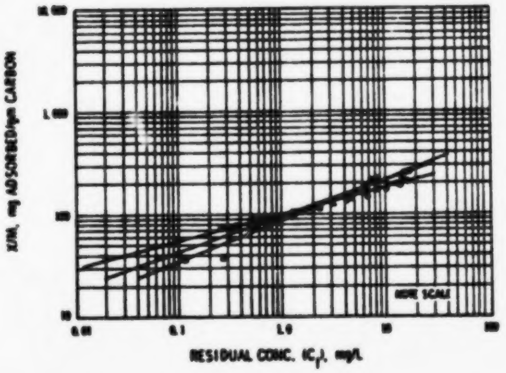
mol. wt.: 139.11 m.p., °C: 45.3 b.p. (760 torr), °C: 216
vapor pressure (49.3°C), torr: 1.0
solubility in water (20°C), mg/L: 2,100
log octanol/water partition coefficient: 1.76
Henry's law constant: Not available
biodegradability: 97% 2-nitrophenol removal (measured as COD removal) obtained at 20% C in activated sludge at a rate of 14 mg COD/g dry innoculum/hr

Probable Fate [1]

photolysis: Slow photolysis is very probable fate
oxidation: Oxidation by hydroxy radical attack; no rate available
hydrolysis: Slight potential for hydrolysis after adsorption by clay materials
volatilization: Volatilization occurs, but is not important
sorption: Adsorbed to a moderate degree by clay minerals
biological processes: No bioaccumulation; very resistant to biodegradation under natural conditions
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 3.0, 5.5, 9.0
type of carbon: Filtrasorb-300
adsorbability: 91 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.5



INDUSTRIAL OCCURRENCE OF 2-NITROPHENOL[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal minimg	ND	19	2.7	0	0.0710.010	
Textile mills	NA	NA	NA	NA	NA	NA
Rubber processing	NA	9.4[d]	9.4[d]	0.000002	0.0081	0.00031

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF 2-NITROPHENOL[a,b]

	Treated wastewater					
	Concentration, mg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Textile mills	NA	4.1[e]	4.1[e]	1.7×10^{-5}	0.12	0.0074
Rubber processing	NA	4.9[e]	4.9[e]	9.8×10^{-7}	0.0042	0.00016
Pharmaceutical manufacturing	ND	4,100	290	0	2.0	0.27
Foundries	<20	40	30	0	0.20	0.081
Iron and steel manufacturing	NA	150	26	0	NA	4.7

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 2-NITROPHENOL[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	150[d]	III.4.1
Sedimentation			>47[d]	<10[d]	III.4.2
Activated sludge	~100	~50	>99[d]	<0.04[d]	III.5.1
Powdered activated carbon adsorption	~100	20			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

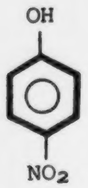
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 88-1 - 88-9.

2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 4-Nitrophenol

Formula:



Alternate Names: p-Nitrophenol,
4-Hydroxynitrobenzene

CAS #: 100-07-7

Physical, Chemical, and Biological Properties [1-3]

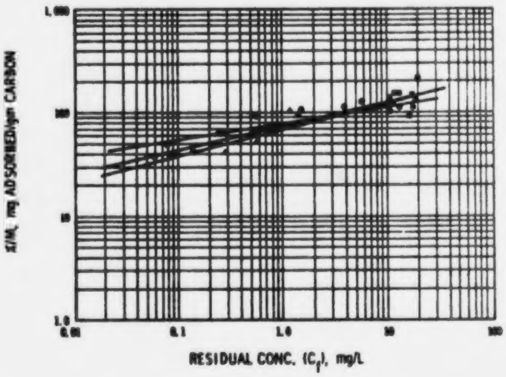
mol. wt.: 139.1   m.p., °C: 115   b.p. (760 torr), °C: Sublimes
vapor pressure (146°C), torr: 2.2
solubility in water (25°C), mg/L: 16,000
log octanol/water partition coefficient: 1.91
Henry's law constant: Not available
biodegradability: 95% 4-nitrophenol removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 18 mg COD/g dry innoculum/hr

Probable Fate [1]

photolysis: Photolysis is slow, but might be the only degradative process which occurs
oxidation: Attack by hydroxy radicals at C-2 and C-4 positions occurs, but no rate is available
hydrolysis: Slight possibility of hydrolysis to 1, 4-benzoquinone after sorption by clay minerals
volatilization: Not important
sorption: Slight potential for irreversible sorption by clay minerals
biological processes: No bioaccumulation; resists biodegradation under natural conditions and inhibits microbial growth
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 3.0, 5.4, 9.0
type of carbon: Filtrasorb-300
adsorbability: 120 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.4



INDUSTRIAL OCCURRENCE OF 4-NITROPHENOL[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	NA	NA	NA	NA	NA
Auto and other laundries	ND	15	13	1.1×10^{-5}	0.018	0.0027
Pharmaceutical manufacturing	ND	3,500	400	0	2.8	0.37
Foundries	ND	NA	400	0	2.7	1.1

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF 4-NITROPHENOL[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	<10[d]	<10[d]	4.2×10^{-5}	0.29	0.018
Auto and other laundries	NA	ND[d]	ND[d]	ND	ND	ND
Pharmaceutical manufacturing	ND	1,100	79	0	0.54	0.073
Foundries	6	20	13	0	0.087	0.035

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 4-NITROPHENOL[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., μg/L	Volume III references, Section numbers
Sedimentation			0[d,e]	-[e]	III.4.2
Sedimentation with chemical addition (lime, polymer)			>9[d]	<10[d]	III.4.3
Aerated lagoons			>23[d]	<10[d]	III.5.3
Activated sludge	~100	<50	>99[d]	<0.9[d]	III.5.1
Powdered activated carbon adsorption	97	60			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 89-1 - 89-8.

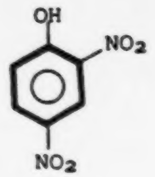
2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. McGraw Hill, Inc. Lange's Handbook of Chemistry, 12th Edition. New York, New York, 1979. p. 7-306.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 2,4-Dinitrophenol

Formula:



Alternate Names: Aldifen, 2,4-DNP

CAS #: 51-28-5

Physical, Chemical, and Biological Properties [1-3]

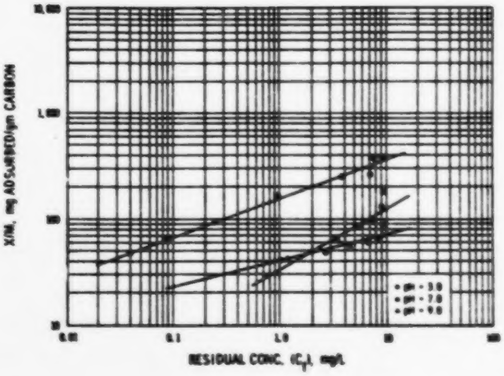
mol. wt.: 184.1 m.p., °C: 114 b.p. (760 torr), °C: Sublimes
vapor pressure (25°C), torr: Not available
solubility in water (18°C), mg/L: 5,600
log octanol/water partition coefficient: 1.53
Henry's law constant: Not available
biodegradability: 85% 2,4-dinitrophenol removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 6.0 mg COD/g dry innoculum/hr

Probable Fate [1]

photolysis: Degradation by slow photolysis may be principal fate
oxidation: Oxidation by hydroxy radicals could occur, but no environmental rate is available
hydrolysis: Slight possibility for hydrolysis after adsorption by clay minerals
volatilization: Not important
sorption: Slight potential for sorption by clay minerals
biological processes: No bioaccumulation; uncertain amount of biodegradation under natural conditions
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 3.0, 7.0, 9.0
type of carbon: Not available
adsorbability: 270 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF 2,4-DINITROPHENOL[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Auto and other laundries	ND	19	19	1.7×10^{-5}	0.027	0.004
Steam electric power generating (ash handling)	NA	NA	50e	0.00095	4.9	1.1
Iron and steel manufacturing	NA	440	33	0	NA	5.9

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF 2,4-DINITROPHENOL[a,b]

	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.7	0	0.018	0.0026
Auto and other laundries	NA	ND[d]	ND[d]	-[e]	-[e]	-[e]
Iron and steel manufacturing	NA	130	53	0	NA	9.5

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 2,4-DINITROPHENOL[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., μg/L	Volume III references, Section numbers
Activated sludge	100	<50			III.5.1
Powdered activated carbon adsorption	~100	40			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 90-1 - 90-9.

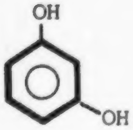
2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. McGraw Hill, Inc. Lange's Handbook of Chemistry, 12th Edition. New York, New York, 1979. p. 7-196.

4. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Resorcinol

Formula:



Alternate Names: *m*-Hydroxyphenol,
1,3-Dihydroxybenzene,
1,3-Benzenediol, Resorcin

CAS #: 108-46-3

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 110.1 m.p., °C: 276-280 b.p. (760 torr), °C: 281 (volatizes at lower temp.)

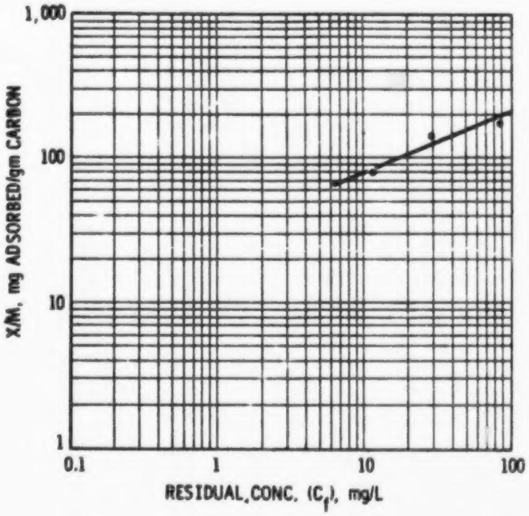
vapor pressure (138°C), torr: 5
solubility in water (30°C), mg/L: 2,290,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 90% resorcinol removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 58 mg COD/g dry innoculum/hr

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data [3]

pH: Not available
type of carbon: Filtrsorb-300
adsorbability: Not available



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF RESORCINOL[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF RESORCINOL[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR RESORCINOL[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

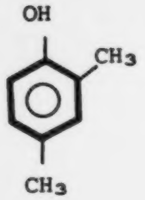
1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 562.

2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. Report on visit of D. Stephan and W. Cawley, U.S. Environmental Protection Agency, to Calgon Environmental Systems Division, Calgon Corporation, Pittsburgh, Pennsylvania, 9 April 1979. 132 pp.

Compound: 2,4-Dimethylphenol

Formula:



Alternate Names: 2,4-Xylenol,
1-Hydroxy-2,4-dimethylbenzene

CAS #: 105-67-9

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 122.2 m.p., °C: 24.5 b.p. (760 torr), °C: 211
vapor pressure (20°C), torr: 0.0621*
solubility in water (160°C), mg/L: 17,000
log octanol/water partition coefficient: 2.50
Henry's law constant: Not available
biodegradability: 95% 2,4-dimethylphenol removed (measured as COD removal) obtained at 20°C in activated sludge at a rate of 28 mg COD/g dry innoculum/hr

---

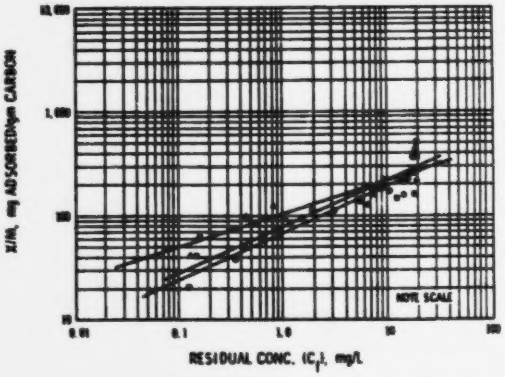
*Vapor pressure as a supercooled liquid.

Probable Fate [1]

photolysis: Photooxidation definitely occurs, but rate and importance are unknown
oxidation: Metal-catalyzed oxidation may occur in aerated surface waters
hydrolysis: Not important
volatilization: Not important
sorption: Slight potential for adsorption onto organic materials
biological processes: Available data are conflicting and inconclusive, but biodegradation can occur
other reactions/interactions: Chlorine present in H_2O could chlorinate the compound

Carbon Adsorption Data [3]

pH: 3.0, 5.8, 9.0
type of carbon: Filtrasorb-300
adsorbability: 130 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.8



INDUSTRIAL OCCURRENCE OF 2,4-DIMETHYL PHENOL[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	22	4.8	0	0.07	0.010
Timber products processing	BDL	6,600	1,300[d]	0	60	0.11
Petroleum refining	NA	NA	100	0	9.3	0.58
Textile mills	NA	NA	NA	NA	NA	NA
Auto and other laundries	ND	460	20	1.8×10^{-8}	0.028	0.0042
Pharmaceutical manufacturing	ND	ND	ND	ND	ND	ND
Ore mining and dressing	270	270	270	0	NA	10
Coil coating	21[e]	21[e]	21[e]	0.001[e]	0.038	0.010
Foundries	ND	1,100	81	0	0.54	0.22
Iron and steel manufacturing	NA	84,000	4,000	0	NA	720
Nonferrous metals manufacturing	ND	14	7	0	NA	0.37

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] Median, not average.

[e] One sample.

INDUSTRIAL OCCURRENCE OF 2,4-DIMETHYLPHENOL[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	$-^{d}$	$-^{d}$	$-^{d}$
Textile mills	NA	8.0^{e}	8.0^{e}	3.4×10^{-5}	0.23	0.014
Timber products processing	BDL	140	BDL	-d	-d	-d
Petroleum refining	NA	8^{e}	8^{e}	0	0.74	0.046
Auto and other laundries	NA	29^{e}	29^{e}	2.6×10^{-5}	0.041	0.0061
Pharmaceutical manufacturing	ND	8.0	2.0	0	0.014	0.0018
Foundries	<10	490	120	0	0.80	0.32
Iron and steel manufacturing	NA	70	10	0	NA	1.8

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 2,4-DIMETHYLPHENOL[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	210	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			>99[d]	<0.1[d]	III.4.5
Gas flotation with chemical addition (polymer)			0[d,e]	-[e]	III.4.5
Filtration			0[e]	-[e]	III.4.6
Sedimentation			18->55	<15	III.4.2
Sedimentation with chemical addition (lime, polymer)			76	<10	III.4.3
Activated sludge	~100	<50	32-95	<9	III.5.1
Granular activated carbon adsorption			>89[d]	<0.1[d]	III.6.1
Powdered activated carbon adsorption	99	130			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

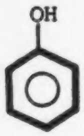
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 91-1 - 91-9.

2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Total phenols **Formula:** Derivatives of phenol



Alternate Names: Hydroxybenzenes,
Phenoyl hydroxides

CAS #: See sections on individual phenols

Physical, Chemical, and Biological Properties

See sections on individual phenols.

Probable Fate [1]

photolysis: Photooxidation is important only for phenol, pentachlorophenol, nitrophenols, and possibly alkyl phenols
oxidation: Can occur, but probably cannot compete with biodegradation
hydrolysis: Probably not important for any phenols
volatilization: Phenols are volatilized very little
sorption: Important for highly chlorinated phenols and possibly for nitrophenols
biological processes: Biodegradation is very important for chlorophenols, but not for nitrophenols
other reactions/interactions: Chlorination by chlorine present in H_2O

Carbon Adsorption Data: See sections on individual phenols

INDUSTRIAL OCCURRENCE OF TOTAL PHENOLS[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Timber products processing	BDL	1,300	75^d	0	3.4	0.0064
Paint and ink formulation	NA	NA	NA	NA	NA	NA
Gum and wood chemicals	460	53,000	8,500	0.076	64	14
Ore mining and dressing	<0.002	0.22	<0.032	0	NA	<0.0012
Steam electric power generating (condenser cooling system)	<10	<100	50	0.0027	0.055	0.012
Steam electric power generating (water treatment)	NA	NA	20^d	1.0×10^{-7d}	1.2^d	0.003^d
Steam electric power generating (drainage)	NA	NA	500^d	0.0043^d	0.18^d	0.010^d
Leather tanning and finishing	110	110,000	1,800	0	NA	2.7
Nonferrous metals manufacturing	ND	28	0.98	0	NA	0.052

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF TOTAL PHENOLS[a,b]

	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Timber products processing	0.048	680	51	0	2.3	0.0044
Paint and ink formulation	BDL	1,900	130	0	0.0060	0.00021
Gum and wood chemicals	29	14,000	3,300	0.030	25	5.4
Auto and other laundries	<1.0	264	62	5.6×10^{-5}	0.087	0.013
Nonferrous metals manufacturing	0.006	25	1.6	0	NA	0.085

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR TOTAL PHENOLS[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	24,000	III.4.1
Gas flotation			4[d]	23,000[d]	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			48-96	410	III.4.5
Gas flotation with chemical addition (polymer)			36->50	210	III.4.5
Gas flotation with chemical addition (alum, polymer)			13[d]	94[d]	III.4.5
Filtration			15-65	65,000	III.4.6
Sedimentation			38-96	390	III.4.2
Sedimentation with chemical addition (alum, lime)			11-22	670	III.4.3
Sedimentation with chemical addition (sulfide)			29-58	190	III.4.3
Sedimentation with chemical addition ($BaCl_2$)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (alum, polymer)			30-60	100	III.4.3
Sedimentation with chemical addition (alum)			17-31	56,000	III.4.3
Sedimentation with chemical addition (lime)			22-33	170	III.4.3
Tertiary polishing lagoons			23-46	40	III.5.3
Aerated lagoons			65->99	11	III.5.3
Trickling filters			79-81->99	72,000-79,000	III.5.2
Ultrafiltration			36-82	83,000	III.4.7
Solvent extraction			98->99		III.5.6
Ozonation			41->99	55	III.6.14
Activated sludge			61->99	<19,000	III.5.1
Powdered activated carbon adsorption (with activated sludge)			>99	23	III.6.2
Granular activated carbon adsorption			58-99	1,100	III.6.1
Reverse osmosis			27-81	13	III.6.9

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

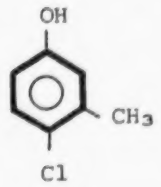
[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 84-1 - 93-8.

Compound: *p*-Chloro-*m*-cresol

Formula:



Alternate Names: 4-Chloro-*m*-cresol,
4-Chloro-3-methylphenol,
2-Chloro-5-hydroxytoluene

CAS #: 59-50-7

Physical, Chemical, and Biological Properties [1]

mol. wt.: 142 m.p., °C: 66 b.p. (760 torr), °C: 235
vapor pressure (25°C), torr: Not available
solubility in water (20°C), mg/L: 3,850
log octanol/water partition coefficient: 2.95
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Based on data for 4-chlorophenol, intramolecular photolysis may be a very important fate
oxidation: Can occur, but probably cannot compete with biodegradation
hydrolysis: Not important
volatilization: Not important
sorption: Data inconclusive, but potential for adsorption by organics exists
biological processes: No data on bioaccumulation; biodegradation data not applicable to environment
other reactions/interactions: Can be chlorinated further by chlorine present in H_2O

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF *p*-CHLORO-*m*-CRESOL[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	168[d]	168[d]	0.00070	4.8	0.30
Petroleum refining	NA	NA	NA	NA	NA	NA
Auto and other laundries	ND	≤10	50	5×10^{-7}	0.0007	0.0001
Foundries	ND	280	42	0	0.28	0.11
Iron and steel manufacturing	NA	4,300	200	0	NA	36

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF p-CHLORO-o-CRESOL[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	32[d]	32[d]	0.00013	0.92	0.058
Petroleum refining	NA	0.2[d]	0.2[d]	0	0.019	0.0012
Foundries	<20	63	41	0	0.27	0.11
Iron and steel manufacturing	NA	NA	27	0	NA	4.9

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR *p*-CHLORO-*m*-CRESOL[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	120[d]	III.4.1
Filtration			0[e]	-[e]	III.4.6
Sedimentation with chemical addition (lime, polymer)			44[d]	62[d]	III.4.3
Activated sludge	~100	<50	65->98	<4	III.5.1
Granular activated carbon adsorption			>83[d]	<0.1[d]	III.6.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

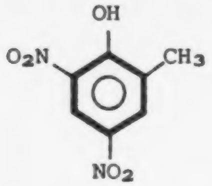
[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 92-1 - 92-7.

Compound: 4,6-Dinitro-*o*-cresol   Formula:



Alternate Names: DNOC, 2,4-Dinitro-6-methyl-phenol

CAS #: 534-52-1

Physical, Chemical, and Biological Properties [1-3]

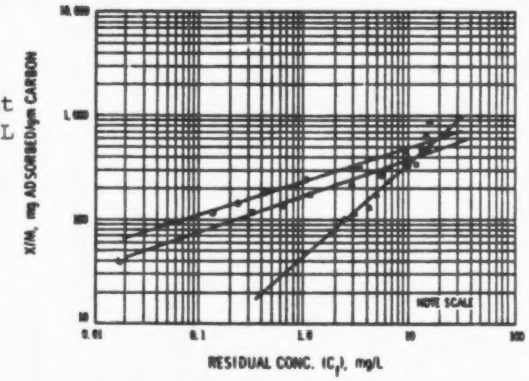
mol. wt.: 198.1   m.p., °C: 85.8   b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: Not available
solubility in water (temp. unknown), mg/L: 250
log octanol/water partition coefficient: 2.85
Henry's law constant: 1.4×10^{-6} atmos. m^3 $mole^{-1}$
biodegradability: 1% removal after 48 hours incubation for initial concentration of 207 mg/L

Probable Fate [1]

photolysis: Gradual photooxidation should occur, but relative importance uncertain
oxidation: Hydroxyl radicals may displace nitro groups
hydrolysis: Hydrolysis may occur after adsorption by clay minerals
volatilization: Not important
sorption: Adsorption by clay should be an important transport process
biological processes: Toxicity rules out bioaccumulation; biodegradation occurs in soil, possibly in water
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 3.0, 5.2, 9.0
type of carbon: Filtrasorb-300
adsorbability: 53 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.2



INDUSTRIAL OCCURRENCE OF 4,6-DINITRO-*o*-CRESOL[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	194	28	0	0.74	0.10
Pharmaceutical manufacturing	ND	ND	ND	ND	ND	ND
Foundries	ND	70	16	0	0.11	0.043
Iron and steel manufacturing	NA	970	130	0	NA	23

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF 4,6-DINITRO-*o*-CRESOL[a,b]

	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	6.7	0.4[d]	0	0.011	0.0015
Pharmaceutical manufacturing	ND	ND	ND	ND	ND	ND
Foundries	7	80	45	0	0.30	0.12
Iron and steel manufacturing	NA	NA	110	0	NA	20

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 4,6-DINITRO-*o*-CRESOL[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., μg/L	Volume III references, Section numbers
Sedimentation			48->95	460	III.4.2
Sedimentation with chemical addition (lime, polymer)			0[d,e]	-[e]	III.4.3
Activated sludge	58	2,100			III.5.1
Powdered activated carbon adsorption	~100	50			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

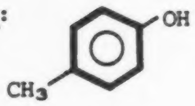
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 93-1 - 93-8.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 275.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Cresol

Formula:



Alternate Names: Cresylic acid, Cresyol, Tricresol, Methylphenol, Hydroxytoluene, Tokresol, Bacillol

CAS #: 1319-77-3

Physical, Chemical, and Biological Properties [1, 2]

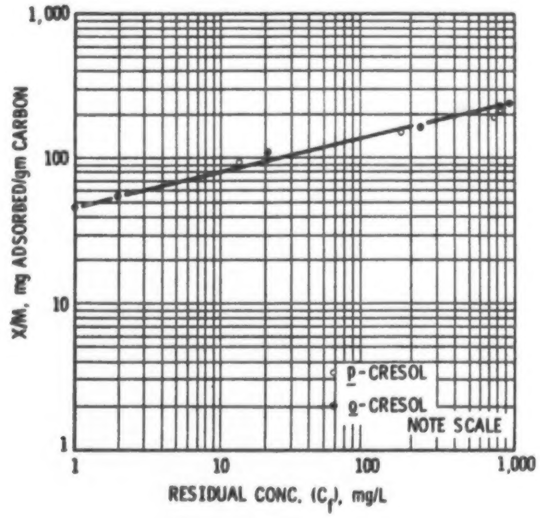
mol. wt.: 108.1   m.p., °C: 10.9-35.5   b.p. (760 torr), °C: 185-205
vapor pressure (38-53°C), torr: 1
solubility in water (40°C), mg/L: 24,000-31,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 96% cresol removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 55 mg COD/g dry innoculum/hr

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data [3]

pH: Not available
type of carbon: Filtrasorb-300
adsorbability: Not available



INDUSTRIAL OCCURRENCE OF CRESOL[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF CRESOL[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CRESOL[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

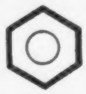
1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part I, pp. 89, 90.

2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. Report on visit of D. Stephan and W. Cawley, U.S. Environmental Protection Agency, to Calgon Environmental Systems Division, Calgon Corporation, Pittsburgh, Pennsylvania, 9 April 1979. 132 pp.

Compound: Benzene

Formula:



Alternate Names: Benzol, Cyclohexatriene

CAS #: 71-43-2

Physical, Chemical, and Biological Properties [1-3]

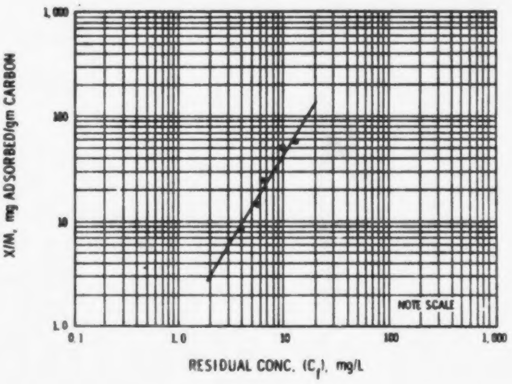
mol. wt.: 78.12 m.p., °C: 5.5 b.p. (760 torr), °C: 80.1
vapor pressure (25°C), torr: 95.2
solubility in water (25°C), mg/L: 1,780-1,800
log octanol/water partition coefficient: Conflicting data reported
Henry's law constant: 5.55×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: 33% theoretical oxidation of 500 ppm benzene by phenol-acclimated sludge after 12 hr aeration

Probable Fate [1]

photolysis: Photooxidation of volatilized benzene is the only form of photolysis which occurs
oxidation: No aqueous oxidation occurs, but volatilized benzene is photooxidized at a rapid rate
hydrolysis: Not important
volatilization: Rapid volatilization (half-life = 4.81 hr) is the primary transport process for benzene
sorption: Benzene should be adsorbed by organic material
biological processes: Low potential for bioaccumulation; metabolized to catechols by many organisms; biodegraded at a slow rate
other reactions/interactions: Not important

Carbon Adsorption Data [43]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 9,000 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF BENZENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	15	2.6	0	0.069	0.0098
Textile mills	NA	200	<5[d]	2.1×10^{-5}	0.14	0.0090
Timber products processing	BDL	2,800	350[e]	0	16	0.030
Petroleum refining	NA	NA	>100	0	9.3	0.58
Paint and ink formulation	ND	9,900	1,200	0	0.055	0.0019
Gum and wood chemicals	BDL	710	180	0.0016	1.3	2.7
Rubber processing	NA	3,400	610	0.00012	0.52	0.020
Pulp, paper and paperboard mills	<1	3	<2	0	NA	0.060
Auto and other laundries	ND	23,000	840	0.00076	1.2	0.18
Pharmaceutical manufacturing	ND	2,100	220	0	0.18	0.20
Ore mining and dressing	ND	4.2	2.1	0	NA	0.078
Steam electric power generating (condenser cooling system)	NA	NA	45[d]	0.0024	0.050	0.011
Steam electric power generating (water treatment)	NA	NA	2[d]	1.2×10^{-8}	0.12	0.0003
Inorganic chemicals manufacturing	NA	15[e]	NA	0	0.94	0.19
Coil coating	<10	<10	<10	<0.0005	<0.018	<0.0048
Foundries	ND	NA	200	0	1.3	0.54
Leather tanning and finishing	ND	150	19	0	NA	0.029
Nonferrous metals manufacturing	ND	160	11	0	NA	0.58
Iron and steel manufacturing	NA	43,000	2,000	0	NA	360

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reporteed in Section I.3, where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF BENZENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<1^{4}	0	0.037	0.0053
Textile mills	NA	64	<5^{d}	2.1 x 10^{-5}	0.14	0.0090
Timber products processing	BDL	33	BDL	-^{e}	-^{e}	-^{e}
Paint and ink formulation	ND	3,800	390	0	0.018	0.00062
Gum and wood chemicals	120	240	170	0.0015	1.2	0.28
Rubber processing	NA	100	29	5.8 x 10^{-6}	NA	NA
Petroleum refining	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	<1	12	<2	0	NA	0.06
Pharmaceutical manufacturing	ND	390	48	0	0.33	0.044
Foundries	<10	60	26	0	0.17	0.07
Iron and steel manufacturing	ND	120,000	1,800	0	NA	324
Nonferrous metals manufacturing	ND	59	4.2	0	NA	0.22
Leather tanning and finishing	ND	<10	<7	0	NA	0.011

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BENZENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gravity oil separation			NA	>75	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			0^d	$-^d$	III.4.5
Gas flotation with chemical addition (polymer)			33^e	12^e	III.4.5
Filtration			28->99	45	III.4.6
Sedimentation			23->63	85	III.4.2
Sedimentation with chemical addition (alum, lime)			50^e	46^e	III.4.3
Sedimentation with chemical addition (lime, polymer)			$0^{d,e}$	$-^d$	III.4.3
Sedimentation with chemical addition (polymer)			$0^{d,e}$	$-^d$	III.4.3
Sedimentation with chemical addition (alum, polymer)			49->97	160	III.4.3
Anaerobic lagoons			50^e	$5,000^e$	III.5.3
Aerated lagoons			56->95	<16	III.5.3
Solvent extraction			90-97	11,000	III.5.6
Activated sludge	~100	<50	49->99	4,100	III.5.1
Powdered activated carbon adsorption	80	4,000	95^d	$20,000^d$	III.6.2
Granular activated carbon adsorption			48->80	73	III.6.1
Reverse osmosis			43-80	1.5	III.6.9

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Actual data indicate negative removal.

[e] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 71-1 - 71-9.

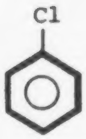
2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. pp. 113-117.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Chlorobenzene

Formula:



Alternate Names: Monochlorobenzene,
Benzene chloride,
Pherol chloride

CAS #: 108-90-7

Physical, Chemical, and Biological Properties [1, 2]

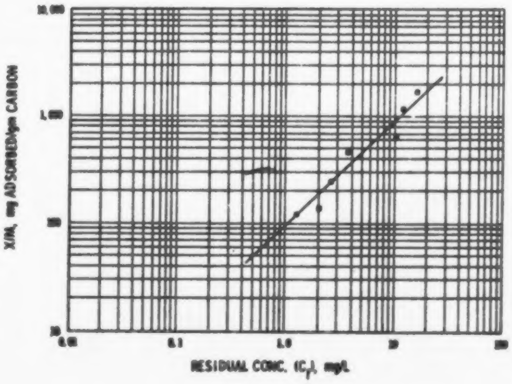
mol. wt.: 112.6 m.p., °C: -45 b.p. (760 torr), °C: 132
vapor pressure (25°C), torr: Conflicting data reported
solubility in water (25°C), mg/L: 472
log octanol/water partition coefficient: 2.84
Henry's law constant: 3.93×10^{-3} atmos. m^3 mole^{-1}
biodegradability: Not available

Probable Fate [1]

photolysis: Probably occurs slowly
oxidation: No data on aqueous oxidation; photooxidation of volatilized chlorobenzene is slower than photooxidation of benzene
hydrolysis: Not important
volatilization: Very rapid volatilization is the main transport process
sorption: Chlorobenzene is presumably sorbed by organic materials
biological processes: High potential for bioaccumulation and magnification; biodegradation very slow
other reactions/interactions: There is a low probability of further chlorinating chlorobenzene by reaction with chlorine-containing water

Carbon Adsorption Data [3]

pH: 7.4
type of carbon: Filtrasorb-300
adsorbability: 97 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF CHLOROBENZENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	300	25[d]	0.00010	0.72	0.045
Auto and other laundries	ND	12	6	5.4×10^{-6}	0.0084	0.0013
Pharmaceutical manufacturing	ND	600	67	0	0.46	0.062
Leather tanning and finishing	ND	NA	1.4	0	NA	0.0021
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	40	3.9	0	NA	0.21

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reporteed in Section I.3, where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF CHLOROBENZENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	3.5[d]	3.5[d]	1.5×10^{-5}	0.10	0.0063
Pharmaceutical manufacturing	ND	200	22	0	0.15	0.020
Foundries	NA	470[d]	470[d]	0	3.10	1.3
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	65	4	0	NA	0.21

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CHLOROBENZENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Filtration			0[d]	-[d]	III.4.6
Activated sludge	~100	<50	71->99	5	III.5.1
Granular activated carbon adsorption			>96[e]	<0.2[e]	III.6.1
Powdered activated carbon adsorption	95	1,400			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Actual data indicate negative removal.

[e] Only one data point.

REFERENCES

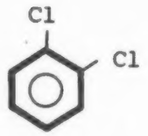
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 72-1 - 72-10.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: 1,2-Dichlorobenzene

Formula:



Alternate Names: *o*-Dichlorobenzene,
Orthodichlorobenzene,
Dowtherm E

CAS #: 95-50-1

Physical, Chemical, and Biological Properties [1-3]

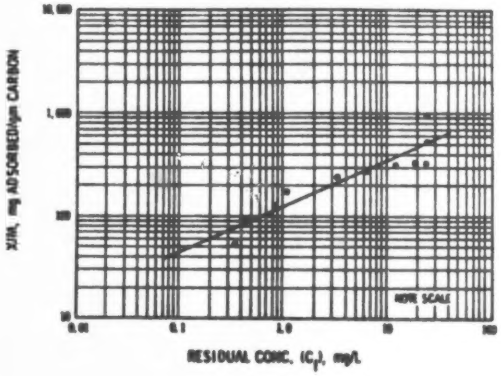
mol. wt.: 147.0 m.p., °C: -17.0 b.p. (760 torr), °C: 180
vapor pressure (25°C), torr: 1.5
solubility in water (25°C), mg/L: 145
log octanol/water partition coefficient: 3.38
Henry's law constant: 1.94×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: 100% decomposition by ring disruption by Pseudomonas of 200 mg/L solution in 72 hr

Probable Fate [1]

photolysis: Probably occurs slowly
oxidation: Resistant to autooxidation by peroxy radical in water; oxidation by hydroxy radicals occurs in atmosphere
hydrolysis: Not important
volatilization: Relatively rapid volatilization occurs; half-life is less than nine hours
sorption: Significant amount of adsorption by organic materials should occur in environment
biological processes: Bioaccumulated more than chlorobenzene; sufficiently resistant to biodegradation to make volatilization more important
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 5.5
type of carbon: Filtrasorb-300
adsorbability: 70 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.5



INDUSTRIAL OCCURRENCE OF 1,2-DICHLOROBENZENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1.2	0	0.032	0.0045
Textile mills	NA	280	2[d]	8.4×10^{-6}	0.58	0.0036
Auto and other laundries[e]	ND	1,100	30	2.7×10^{-5}	0.042	0.0063
Pharmaceutical manufacturing	ND	ND	ND	ND	ND	ND
Steam electric power generating (condenser cooling system)[e]	<10	26	20	0.0011	0.022	0.0040
Steam electric power generating (ash handling)[e]	NA	65	53	0.001	5.3×10^{-5}	1.2
Leather tanning and finishing	ND	200	69	0	NA	0.10

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Analytical method did not distinguish between dichlorobenzene isomers.

INDUSTRIAL OCCURRENCE OF 1,2-DICHLOROBENZENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<1.5	0	0.040	0.0057
Textile mills	NA	20	10[d]	0.000042	0.029	0.018
Pharmaceutical manufacturing	ND	ND	ND	-[e]	-[e]	-[e]
Iron and steel manufacturing	NA	NA	15	0	NA	2.7
Leather tanning and finishing	ND	69	13	0	NA	0.020

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,2-DICHLOROBENZENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gas flotation with chemical addition (calcium chloride, polymer)			76[d]	260[d]	III.4.5
Filtration			50->94	3.8	III.4.6
Sedimentation with chemical addition (alum, lime)			>99[d]	<0.05[d]	III.4.3
Sedimentation with chemical addition (alum)			25->50	<12	III.4.3
Aerated lagoons			>96[d]	<10[d]	III.5.3
Activated sludge	66	1,700	73->99	<8	III.5.1
Granular activated carbon adsorption			>99	<0.05	III.6.1
Powdered activated carbon adsorption	99	330			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 73-1 - 73-8.

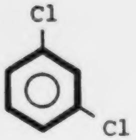
2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. pp. 224, 225.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 1,3-Dichlorobenzene

Formula:



Alternate Names: *m*-Dichlorobenzene,
Metadichlorobenzene

CAS #: 541-73-1

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 147.0   m.p., °C: -24.7   b.p. (760 torr), °C: 173

vapor pressure (25°C), torr: 2.28

solubility in water (temp. unknown), mg/L: 123

log octanol/water partition coefficient: 3.38

Henry's law constant: 2.63×10^{-3} atmos. m^3 $mole^{-1}$

biodegradability: 100% degradation through ring disruption by Pseudomonas at 30°C of a 200 mg/L solution in 96 hr

Probable Fate [1]

photolysis: Probably occurs slowly

oxidation: No data on aqueous oxidation; oxidized by hydroxy radicals in atmosphere

hydrolysis: Not important

volatilization: Volatilizes at a relatively rapid rate; half-life approximately ten hours

sorption: Presumably sorbed by organic materials

biological processes: Bioaccumulates more than chlorobenzene; too resistant to biodegradation to compete with volatilization

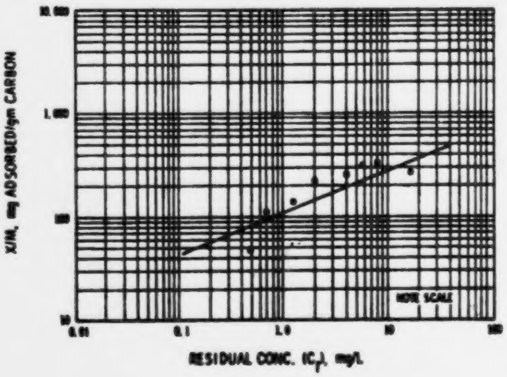
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 5.1

type of carbon: Filtrasorb-300

adsorbability: 76 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.1



INDUSTRIAL OCCURRENCE OF 1,3-DICHLOROBENZENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Auto and other laundries[d]	ND	1,100	30	2.7×10^{-5}	0.042	0.0063
Steam electric power generating (condenser cooling system)[d]	<10	26	20	0.0011	0.022	0.0048
Steam electric power generating (water treatment)	NA	NA	1	6.1×10^{-9}	0.060	0.00015
Steam electric power generating (ash handling)[d]	NA	65	53	0.0010	5.2	1.2
Iron and steel manufacturing	NA	NA	79	0	NA	14

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between the dichlorobenzene isomers.

INDUSTRIAL OCCURRENCE OF 1,3-DICHLOROBENZENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Iron and steel manufacturing	NA	NA	2	0	NA	0.36

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,3-DICHLOROBENZENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	3[d]	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			76[d]	260[d]	III.4.5
Activated sludge	69	1,550			III.5.1
Powdered activated carbon adsorption	98	480			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 74-1 - 74-8.

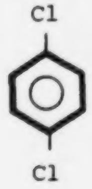
2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 226.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 1,4-Dichlorobenzene

Formula:



Alternate Names: *p*-Dichlorobenzene,
Paradichlorobenzene,
Paramoth

CAS #: 106-46-7

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 147.0 m.p., °C: 53.1 b.p. (760 torr), °C: 174 (Sublimes at ordinary temperatures)

vapor pressure (25°C), torr: 1.18 (calculated)

solubility in water (25°C), mg/L: 79

log octanol/water partition coefficient: 3.39

Henry's law constant: 2.72×10^{-3} atmos. m^3 $mole^{-1}$

biodegradability: 100% degradation through ring disruption by Pseudomonas of a 200 mg/L solution at 30°C in 92 hr

Probable Fate [1]

photolysis: Probably occurs slowly

oxidation: Resistant to autooxidation by peroxy radical in water; oxidized by hydroxy radicals in atmosphere

hydrolysis: Not important

volatilization: Volatilizes at a relatively rapid rate; half-life less than 12 hours

sorption: Presumably adsorbed by organic materials

biological processes: Bioaccumulates more than chlorobenzene; too resistant to biodegradation to compete with volatilization

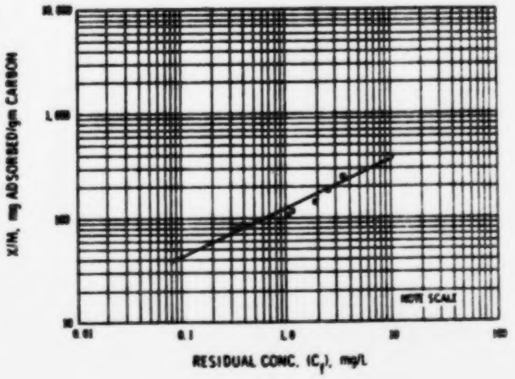
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 5.1

type of carbon: Filtrasorb-300

adsorbability: 74 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.1



INDUSTRIAL OCCURRENCE OF 1,4-DICHLOROBENZENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1.1	0	0.029	0.0014
Textile mills	NA	220	110[d]	0.00046	3.2	0.20
Auto and other laundries[e]	ND	1,100	30	2.7×10^{-5}	0.042	0.0063
Pharmaceutical manufacturing	ND	5	0.55	0	0.0037	0.5
Steam electric power generating (condenser cooling system)[e]	<10	26	20	0.0011	0.022	0.0048
Steam electric power generating (ash handling)[e]	NA	65	53	0.001	5.2	0.0013
Leather tanning and finishing	NA	NA	15	0	NA	0.022
Nonferrous metals manufacturing	ND	26	4.3	0	NA	0.23

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF 1,4-DICHLOROBENZENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1.3	0	0.034	0.0049
Textile mills	NA	1.5	0.8[d]	3.4×10^{-6}	0.023	0.0014
Pharmaceutical manufacturing	ND	1.0	0.11	0	0.00075	0.00010
Iron and steel manufacturing	NA	NA	73	0	NA	13
Leather tanning and finishing	ND	21	5	0	NA	0.0075

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,4-DICHLOROBENZENE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers
Gas flotation with chemical addition (calcium chloride, polymer)			76[d]	260[d]	III.4.5
Aerated lagoons			>81[d]	<10[d]	III.5.3
Activated sludge	61	1,950	>82->99	<5	III.5.1
Powdered activated carbon adsorption	98	330			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

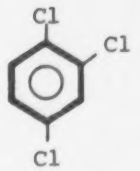
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 75-1 - 75-2.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 226.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 1,2,4-Trichlorobenzene **Formula:**



Alternate Names: unsym-Trichlorobenzene

CAS #: 120-82-1

Physical, Chemical, and Biological Properties [1-4]

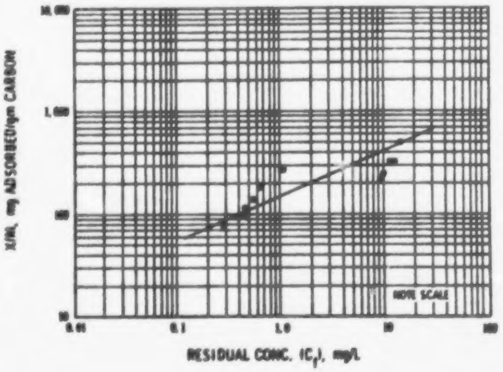
mol. wt.: 181.4 m.p., °C: 17.0 b.p. (760 torr), °C: 214
vapor pressure (25°C), torr: 0.42 (calculated)
solubility in water (temp. unknown), mg/L: 30
log octanol/water partition coefficient: 4.26
Henry's law constant: 1.42×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: 92% ring disruption by Pseudomonas at 30°C of a 200 mg/L solution in 120 hr

Probable Fate [1]

photolysis: Probably occurs slowly
oxidation: Oxidized by hydroxy radicals after volatilization
hydrolysis: Not important
volatilization: Very rapid volatilization can be hindered by adsorption if organics are present
sorption: High potential for adsorption by organic materials
biological processes: High potential for bioaccumulation; very little, if any biodegradation due to volatilization and adsorption
other reactions/interactions: Not important

Carbon Adsorption Data [5]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 57 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF 1,2,4-TRICHLOROBENZENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	2,700	410[d]	0.0017	12	0.74
Steam electric power generating (condenser cooling system)	NA	NA	10[e]	5.3×10^{-4}	0.011	0.0024
Foundries	ND	NA	7	0	0.047	0.0019
Nonferrous metals manufacturing	ND	260	22	0	NA	1.2

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF 1,2,4-TRICHLOROBENZENE[a]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	1,500	610	0.0026	18	1.1
Foundries	<20	570	290	0	1.9	0.78
Nonferrous metals manufacturing	ND	47	4.4	0	NA	0.0066

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,2,4-TRICHLOROBENZENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Filtration			37[d]	94[d]	III.4.6
Sedimentation			0[d,e]	-[e]	III.4.2
Sedimentation with chemical addition (alum, lime)			91[d]	150[d]	III.4.3
Sedimentation with chemical addition (alum)			90[d]	150[d]	III.4.3
Activated sludge	70	1,500	67->99	98	III.5.1
Granular activated carbon adsorption			>93[d]	<0.04[d]	III.6.1
Powdered activated carbon adsorption	97	380			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 76-1 - 76-10.

2. Spencer, W. F. and W. J. Farmer. Assessment of the Vapor Behavior of Toxic Organic Chemicals. Contribution of Federal Research, SEA, USDA, and the University of California, Riverside, California.

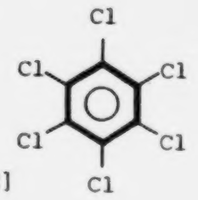
3. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 604.

4. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

5. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Hexachlorobenzene

Formula:



Alternate Names: Perchlorobenzene, HCB

CAS #: 118-74-1

Physical, Chemical, and Biological Properties [1, 2]

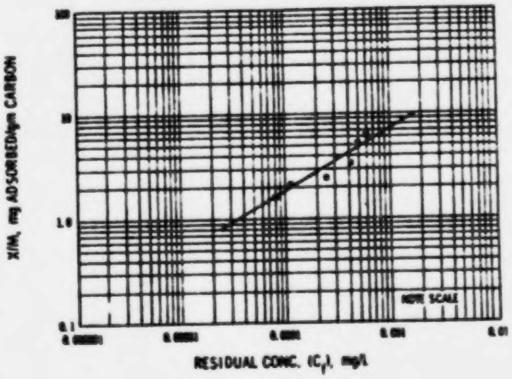
mol. wt.: 284.8 m.p., °C: 230 b.p. (760 torr), °C: 322
vapor pressure (20°C), torr: 1.09×10^{-5}
solubility in water (25°C), μg/L: 6
log octanol/water partition coefficient: 6.18
Henry's law constant: 1.70×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: No degradation by Pseudomonas at 30°C in 120 hr

Probable Fate [1]

photolysis: Extremely slow under environmental conditions
oxidation: Not important
hydrolysis: Not important
volatilization: Probably not important
sorption: Strongly sorbed by particulate matter
biological processes: Strongly bioaccumulated by many organisms; extremely slow biodegradation
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 20 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF HEXACHLOROBENZENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	2	1.3[d]	5.5×10^{-6}	0.037	0.0023
Nonferrous metals manufacturing	ND	5,000	220	0	NA	12

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF HEXACHLOROBENZENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	NA	NA	NA	NA	NA
Iron and steel manufacturing	NA	NA	210	0	NA	38
Nonferrous metals manufacturing	ND	220	30	0	NA	1.6

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR HEXACHLOROBENZENE[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., μg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., μg/L	Volume III references, Section numbers
Aerated lagoons			0[d,e]	-[e]	III.5.3
Activated sludge	56	2,200	47->97	0.4	III.5.1
Powdered activated carbon adsorption	90	79,000			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

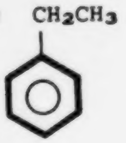
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 77-1 - 77-13.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Ethylbenzene

Formula:



Alternate Names: Phenylethane, Ethylbenzol

CAS #: 100-41-4

Physical, Chemical, and Biological Properties [1-3]

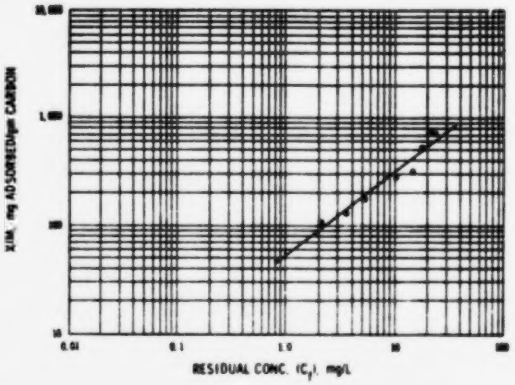
mol. wt.: 106.2 m.p., °C: -94.9 b.p. (760 torr), °C: 136
vapor pressure (20°C), torr: 7
solubility in water (25°C), mg/L: 206
log octanol/water partition coefficient: 3.15
Henry's law constant: 6.44 atmos. m^3 $mole^{-1}$
biodegradability: 27% theoretical oxidation of 500 ppm solution by phenol-acclimated activated sludge after 12 hr aeration

Probable Fate [1]

photolysis: Photooxidation after volatilization is the principal fate of ethylbenzene
oxidation: Not important other than in the case of photooxidation
hydrolysis: Not important
volatilization: Principal transport process for ethylbenzene
sorption: Probably adsorbed by organic materials
biological processes: Very little potential for bioaccumulation; can be used as sole carbon source by some microbes
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 7.3
type of carbon: Filtrasorb-300
adsorbability: 170 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF ETHYLBENZENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<1	0	0.026	0.0038
Textile mills	NA	2,800	54[d]	0.00023	1.6	0.097
Timber products processing	BDL	2,100	37[d]	0	1.7	0.0032
Petroleum refining	NA	NA	>100[d]	0	9.3	0.58
Paint and ink formulation	ND	15,000	3,400	0	0.16	0.0054
Gum and wood chemicals	20	28,000	4,700	0.042	35	7.7
Rubber processing	NA	500	1,500	0.00030	1.3	0.049
Pulp, paper and paperboard mills	NA	<1[e]	<1[e]	0	NA	0.030
Auto and other laundries	ND	17,000	550	0.00050	0.77	0.12
Pharmaceutical manufacturing	ND	86	16	0	1.1×10^{-1}	1.5×10^{-2}
Ore mining and dressing	ND	8.8	4.4	0	NA	0.16
Steam electric power generating (water treatment)	NA	NA	3[f]	1.8×10^{-8}	0.18	0.00045
Coil coating	NA	<10[e]	<10[e]	0.00050	0.0048	0.018
Foundries	ND	NA	39	0	0.26	0.11
Leather tanning and finishing	ND	NA	65	0	NA	9.8×10^{-2}
Nonferrous metals manufacturing	ND	21	2.5	0	NA	0.13
Iron and steel manufacturing	NA	39,000	61	0	NA	11

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] One sample.

[f] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF ETHYLBENZENE[a,b]

Industry	Treated wastewater					
	Concentration, mg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<0.9	0	0.024	0.0034
Textile mills	NA	3,000	63[d]	0.00026	1.8	0.11
Timber products processing	BDL	140	20[e]	0	0.92	0.0017
Petroleum refining	NA	NA	NA	NA	NA	NA
Paint and ink formulation	ND	74,000	4,100	0	0.19	0.0066
Gum and wood chemicals	BDL	10[f]	10[f]	9.0×10^{-5}	0.076	0.016
Rubber processing	NA	>100	>26	5.2×10^{-6}	0.022	0.00086
Pulp, paper and paperboard mills	<1	74	<16	0	NA	0.48
Auto and other laundries	NA	110[e]	110[e]	0.00010	0.154	0.023
Pharmaceutical manufacturing	ND	11	1.6	0	0.011	0.0015
Foundries	NA	<20[e]	<20[e]	0	0.13	0.054
Iron and steel manufacturing	NA	4,400	110	0	NA	20
Nonferrous metals manufacturing	ND	49	1.9	0	NA	0.10
Leather tanning and finishing	ND	12	5	0	NA	0.0075

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ETHYLBENZENE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers
Gravity oil separation			NA	>50	III.4.1
Gas flotation			>99[d]	ND	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			40->99	280	III.4.5
Gas flotation with chemical addition (polymer)			65[d]	160[d]	III.4.5
Gas flotation with chemical addition (alum, polymer)			0[d,e]	-[e]	III.4.5
Filtration			>75->99	<2.1	III.4.6
Sedimentation			47-78	1,000	III.4.6
Sedimentation with chemical addition (alum, lime)			>97-98	11	III.4.3
Sedimentation with chemical addition (polymer)			81[d]	130[d]	III.4.3
Sedimentation with chemical addition (alum, polymer)			>80->94	430	III.4.3
Sedimentation with chemical addition (alum)			0[e]	-[e]	III.4.3
Aerated lagoons			>78->94	<10	III.5.3
Solvent extraction			97[d]	4,000[d]	III.5.6
Activated sludge	~100	<50	30->99	170	III.5.1
Powdered activated carbon adsorption	91	2,100	87[d]	18,000	III.6.2
Granular activated carbon adsorption			0[d,e]	-[e]	III.6.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 78-1 - 78-5.

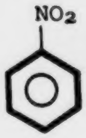
2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. pp. 307-309.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Nitrobenzene

Formula:



Alternate Names: Nitrobenzol,
Oil of mirbane

CAS #: 98-95-3

Physical, Chemical, and Biological Properties [1-3]

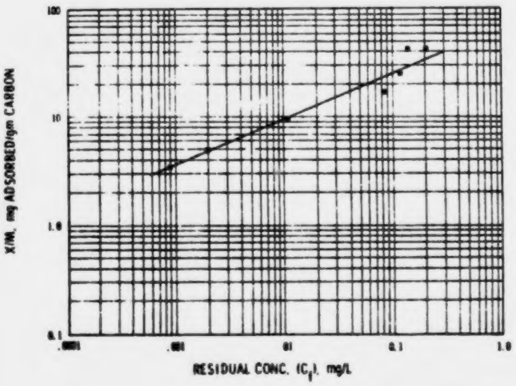
mol. wt.: 123.1 m.p., °C: 5.6 b.p. (760 torr), °C: 211
vapor pressure (20°C), torr: 0.15
solubility in water (20°C), mg/L: 1,900
log octanol/water partition coefficient: 1.85
Henry's law constant: 2.40×10^{-5} atmos. m^3 $mole^{-1}$
biodegradability: 98% nitrobenzene removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 14 mg COD/g dry innoculum/hr

Probable Fate [1]

photolysis: Photoreduction could occur if nitrobenzene is adsorbed onto humus particles
oxidation: Only important as method of destroying photoreduction products
hydrolysis: Not important
volatilization: Not fast enough to be important
sorption: Adsorbed by humus and probably by clay
biological processes: No bioaccumulation of any significance; biodegradation is relatively slow
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 7.5
type of carbon: Filtrasorb-300
adsorbability: 130 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF NITROBENZENE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	7	0.9	0	0.024	0.0034
Paint and ink formulation	ND	180	100	0	0.0046	0.00016
Pharmaceutical manufacturing	ND	ND	ND	ND	ND	ND
Foundries	ND	280	94	0	0.063	0.25
Leather tanning and finishing	ND	NA	73	0	NA	0.11
Iron and steel manufacturing	NA	NA	1,400	0	NA	252
Nonferrous metals manufacturing	ND	160	11	0	NA	0.58

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF NITROBENZENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Paint and ink formulation	ND	7,200	1,800	0	0.083	0.0029
Pharmaceutical manufacturing	ND	ND	ND	-[d]	-[d]	-[d]
Foundries	<20	<20	<20	0	0.13	0.054
Iron and steel manufacturing	NA	NA	6	0	NA	1.1
Nonferrous metals manufacturing	ND	5.5	2.8	0	NA	0.15

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR NITROBENZENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Sedimentation			>52[d]	<10[d]	III.4.2
Sedimentation with chemical addition (alum)			68[d]	35[d]	III.4.3
Activated sludge	~100	<50			III.5.1
Aerated lagoons			>0[d,e]	-[e]	III.5.3
Powdered activated carbon adsorption	100	0.9	79[d]	67,000[d]	III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 79-1 - 79-8.

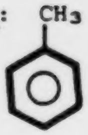
2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Toluene

Formula:



Alternate Names: Toluol, Phenylmethane, Methylbenzene, Methylbenzol, Methacide

CAS #: 108-88-3

Physical, Chemical, and Biological Properties [1, 2]

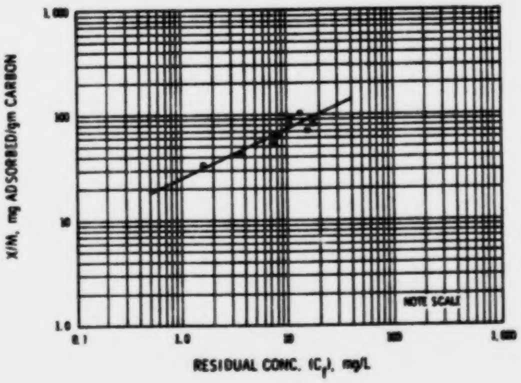
mol. wt.: 92.13 m.p., °C: -95 b.p. (760 torr), °C: 111
vapor pressure (25°C), torr: 28.7
solubility in water (25°C), mg/L: 535
log octanol/water partition coefficient: 2.69
Henry's law constant: 5.93×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Amount of dissociation to benzyl alcohol and benzaldehyde unknown; atmospheric photooxidation to benzaldehyde follows volatilization, probably principle fate
oxidation: Only important as photooxidation
hydrolysis: Not important
volatilization: Volatilization occurs with a half-life of about five hours
sorption: Presumably adsorbed by organic materials
biological processes: Bioaccumulation not important; metabolization produces acids (acetic, pyruvic, and hippuric)
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 5.6
type of carbon: Filtrasorb-300
adsorbability: 340 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.6



INDUSTRIAL OCCURRENCE OF TOLUENE[a,b]

	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	8	1.1	0	0.029	0.0041
Textile mills	NA	620	26[d]	0.00011	0.75	0.047
Timber products processing	BDL	3,200	180[e]	0	8.3	0.015
Petroleum refining	NA	NA	>100[d]	0	9.3	0.58
Paint and ink formulation	ND	260,000	10,000	0	0.46	0.016
Gum and wood chemicals	20	17,000	2,600	0.023	20	4.3
Rubber processing	0	350	77	1.5×10^{-5}	0.066	0.0025
Pulp, paper and paperboard mills	<1	14	<4	0	NA	0.12
Auto and other laundries	ND	51,000	1,300	0.0012	1.8	0.00021
Pharmaceutical manufacturing	ND	17,000	2,400	0	16.3	2.2
Ore mining and dressing	ND	0.64	0.36	0	NA	0.013
Steam electric power generators (water treatment)	NA	NA	98[e]	6×10^{-7}	5.9	0.015
Coil coating	<10	<10	<10	<0.0005	<0.018	<0.0048
Foundries	ND	NA	120	0	0.80	0.32
Leather tanning and finishing	ND	400	67	0	NA	0.10
Nonferrous metals manufacturing	ND	55	6.9	0	NA	0.37
Iron and steel manufacturing	NA	17,000	590	0	NA	106

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF TOLUENE[a,b]

Industry	Treated wastewater					
	Concentration, mg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	7.3	17	0	0.045	0.0064
Textile mills	NA	1,400	14[d]	5.9×10^{-5}	0.40	0.025
Timber products processing	BDL	33	BDL	-[e]	-[e]	-[e]
Petroleum refining	NA	35[f]	35[f]	0	3.2	0.20
Paint and ink formulation	ND	1,100	590	0	0.027	0.00094
Gum and wood chemials	10	2,000	660	0.0059	5.0	1.1
Rubber processing	NA	420	77	1.5×10^{-5}	0.066	0.0025
Pulp, paper and paperboard mills	<1	55	<7	0	NA	0.21
Auto and other laundries	6	790	400	0.00036	0.56	0.084
Pharmaceutical manufacturing	ND	700	97	0	0.66	0.089
Foundries	<10	180	41	0	0.27	0.11
Iron and steel manufacturing	NA	NA	190	0	NA	34
Nonferrous metals manufacturing	ND	69	1.7	0	NA	0.09
Leather tanning and finishing	ND	<10	<8	0	NA	0.012

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Mean pollutant concentration below detection limit.

[f] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR TOLUENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	>65	III.4.1
Gas flotation			>92[d]	ND	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			19-65	1,000	III.4.5
Gas flotation with chemical addition (polymer)			59[d]	130[d]	III.4.5
Gas flotation with chemical addition (alum, polymer)			10[d]	4.5[d]	III.4.5
Sedimentation with chemical addition (alum, lime)			76-96	43	III.4.3
Sedimentation with chemical addition (lime, polymer)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (polymer)			20-39	950	III.4.3
Sedimentation with chemical addition (alum, polymer)			18-73	990	III.4.3
Sedimentation with chemical addition (alum)			49-93	1,260	III.4.3
Sedimentation with chemical addition (lime)			0[d,e]	-[e]	III.4.3
Aerated lagoons			>72->95	<14	III.5.3
Steam stripping			95-96	1,950	III.5.6
Ozonation			15-31	1	III.6.14
Activated sludge	~100	<50	49->99	57	III.5.1
Granular activated carbon adsorption			38->99[d]	80[d]	III.6.1
Powdered activated carbon adsorption	91	1,700			III.6.2
Reverse osmosis			3.8-12	17.5	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

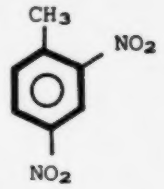
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 80-1 - 80-7.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 2,4-Dinitrotoluene

Formula:



Alternate Names: Dinitrotoluol, DNT,
1-Methyl-2,4-dinitrotoluene

CAS #: 121-14-2

Physical, Chemical, and Biological Properties [1]

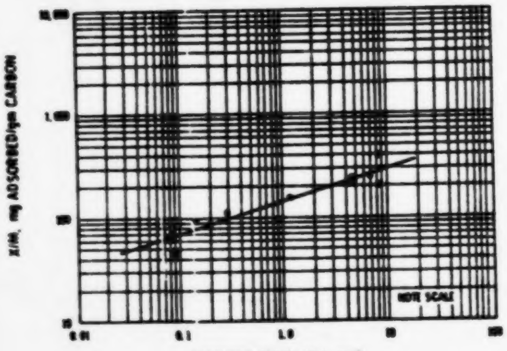
mol. wt.: 182.1 m.p., °C: 70 b.p. (760 torr), °C: 300
vapor pressure (59°C), torr: 0.0013
solubility in water (22°C), mg/L: 270
log octanol/water partition coefficient: 2.01
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Intramolecular photolysis could be an important fate
oxidation: Oxidation could follow adsorption onto clay particles
hydrolysis: Not important
volatilization: Too slow to be important
sorption: 2,4-Dinitrotoluene should be strongly sorbed by humus and clay
biological processes: Some bioaccumulation possible; biodegradation very slow
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 5.4
type of carbon: Filtrasorb-300
adsorbability: 62 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.4



INDUSTRIAL OCCURRENCE OF 2,4-DINITROTOLUENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	6	0.8	0	0.021	0.0030
Pharmaceutical manufacturing	ND	49	12	0	0.082	0.011
Foundries	ND	<50	15	0	0.10	0.041
Iron and steel manufacturing	NA	NA	710	0	NA	0.13
Nonferrous metals manufacturing	ND	16	1.7	0	NA	0.090

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF 2,4-DINITROTOLUENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Pharmaceutical manufacturing	ND	ND	ND	-[d]	-[d]	-[d]
Foundries	<17	300	160	0	1.1	0.43
Iron and steel manufacturing	NA	NA	22	0	NA	4.0
Nonferrous metals manufacturing	ND	7	0.9	0	NA	0.048

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 2,4-DINITROTOLUENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Sedimentation			80[d,e]	10[d,e]	III.4.2
Aerated lagoons			0[d,f]	-[f]	III.5.3
Activated sludge	77	1,650			III.5.1
Powdered activated carbon adsorption	99	90			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Analytical method did not distinguish betweem 2,4-dinitrotoluene and 2,6-dinitrotoluene.

[f] Actual data indicate negative removal.

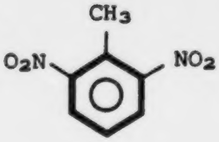
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 81-1 - 81-8.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 2,6-Dinitrotoluene

Formula:



Alternate Names: Dinitrotoluol

CAS #: 606-20-2

Physical, Chemical, and Biological Properties [1]

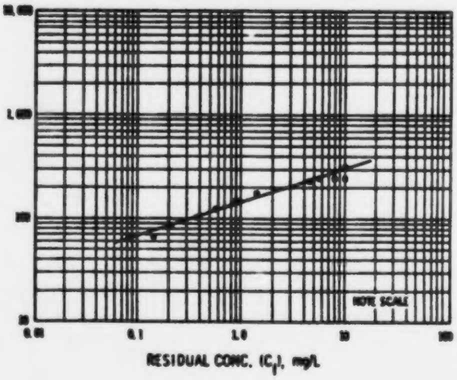
mol. wt.: 182.1 m.p., °C: 65 b.p. (760 torr), °C: 285
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Not available
log octanol/water partition coefficient: 2.05
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Intramolecular photolysis could be very important
oxidation: Photooxidation can occur
hydrolysis: Not important
volatilization: Probably not an important transport process
sorption: 2,6-Dinitrotoluene should be strongly sorbed by humus and clay
biological processes: No data on bioaccumulation; biodegradation very slow
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 5.4
type of carbon: Filtrasorb-300
adsorbability: 62 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.4



INDUSTRIAL OCCURRENCE OF 2,6-DINITROTOLUENE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	54[d]	54[d]	0.00023	1.6	0.097
Foundries	ND	<50	17	0	0.11	0.046
Nonferrous metals manufacturing	ND	16	1.7	0	NA	0.090
Iron and steel manufacturing	NA	47	25	0	NA	4.5

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3, where mean is not available one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF 2,6-DINITROTOLUENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	NA	NA	NA	NA	NA
Foundries	<17	300	160	0	1.1	0.43
Iron and steel manufacturing	NA	NA	7	0	NA	1.3
Nonferrous metals manufacturing	ND	1.0	0.1	0	NA	0.0053

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 2,6-DINITROTOLUENE[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Sedimentation			80[d,e]	10[d,e]	III.4.2
Sedimentation with chemical addition (lime)			>79[d]	<10[d]	III.4.3
Aerated lagoons			83[d]	2[d]	III.5.3
Activated sludge	82	900	0[d,f]	-[f]	III.5.1
Powdered activated carbon adsorption	99	140			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Analytical method did not distinguish between 2,4-dinitrotoluene and 2,6-dinitrotoluene.

[f] Actual data indicate negative removal.

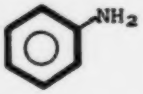
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 82-1 - 82-9.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Aniline

Formula:



Alternate Names: Aminobenzene, Phenylamine,
Aminophen

CAS #: 62-53-3

Physical, Chemical, and Biological Properties [1, 2]

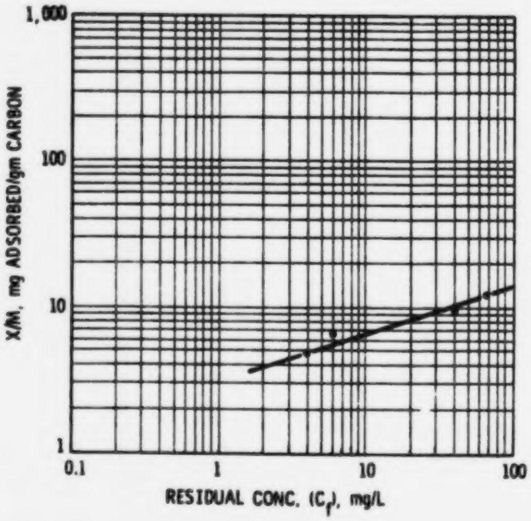
mol. wt.: 93.1 m.p., °C: -6 b.p. (760 torr), °C: 184
vapor pressure (20°C), torr: 0.3
solubility in water (temp. unknown), mg/L: 34,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 95% aniline removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 19 mg COD/g dry innoculum/hr

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data [3]

pH: 7.1
type of carbon: Filtrasorb-300
adsorbability: Not available



INDUSTRIAL OCCURRENCE OF ANILINE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ANILINE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ANILINE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

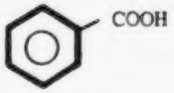
1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 102.

2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. Report on visit of D. Stephan and W. Cawley, U.S. Environmental Protection Agency, to Calgon Environmental Systems Division, Calgon Corporation, Pittsburgh, Pennsylvania, 9 April 1979. 132 pp.

Compound: Benzoic acid

Formula:



Alternate Names: Benzenecarboxylic acid

CAS #: 65-85-0

Physical, Chemical, and Biological Properties [1, 2]

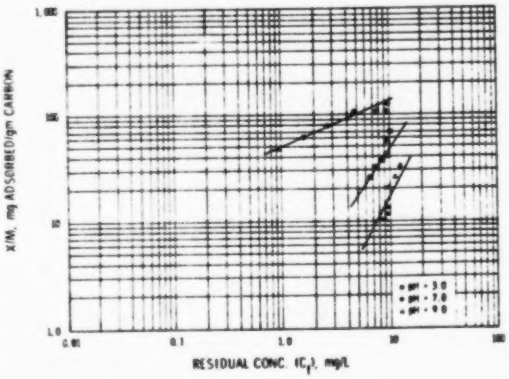
mol. wt.: 122.1 m.p., °C: 122 b.p. (760 torr), °C: 249
vapor pressure (25°C), torr: Not available
solubility in water (20°C), mg/L: 2,900
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 99% benzoic acid removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 88 mg COD/g dry innoculum/hr

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data [3]

pH: 3.0, 7.0, 9.0
type of carbon: Filtrasorb-300
adsorbability: >10,000 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF BENZOIC ACID[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF BENZOIC ACID[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BENZOIC ACID[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Powdered activated carbon adsorption	91	920			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

REFERENCES

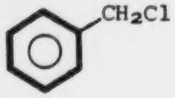
1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 120.

2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

3. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Benzylchloride

Formula:



Alternate Names: α-Chlorotoluene

CAS #: 100-44-7

Physical, Chemical, and Biological Properties [1]

mol. wt.: 126.6   m.p., °C: -43 to -48   b.p. (760 torr), °C: 179
vapor pressure (22°C), torr: 1
solubility in water (25°C), mg/L: Not available
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF BENZYL CHLORIDE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF BENZYL CHLORIDE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BENZYL CHLORIDE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

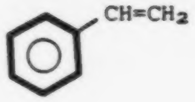
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 126.

Compound: Styrene

Formula:



Alternate Names: Vinylbenzene, Cinnamene,
Phenylethylene, Ethylbenzene

CAS #: 100-42-5

Physical, Chemical, and Biological Properties [1]

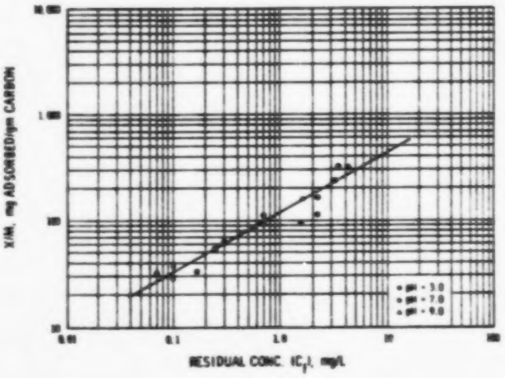
mol. wt.: 104.1 m.p., °C: -30.6 b.p. (760 torr), °C: 145
vapor pressure (20°C), torr: 5
solubility in water (20°C), mg/L: 300
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data [2]

pH: 3.0, 7.0, 9.0
type of carbon: Filtrasorb-300
adsorbability: 74 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF STYRENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF STYRENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR STYRENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Solvent extraction			>93[d]	<1,000[d]	III.5.6
Powdered activated carbon adsorption	99	70			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

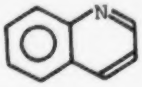
REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 567.

2. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Quinoline

Formula:



Alternate Names: Benzo(b)pyridine, 1-Benzazine,
Lencoline

CAS #: 91-22-5

Physical, Chemical, and Biological Properties [1]

mol. wt.: 129.2 m.p., °C: -15 b.p. (760 torr), °C: 238
vapor pressure (60°C), torr: 1
solubility in water (temp. unknown), mg/L: 60,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF QUINOLINE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF QUINOLINE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR QUINOLINE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 560.

Compound: Xylenes

Formula: $CH_3(C_6H_4)CH_3$ and various derivatives

Alternate Names: Dimethylbenzenes, Methyltoluenes

CAS #: Different for each compound; *o*-Xylene has CAS # 95-47-6

Physical, Chemical, and Biological Properties [1]

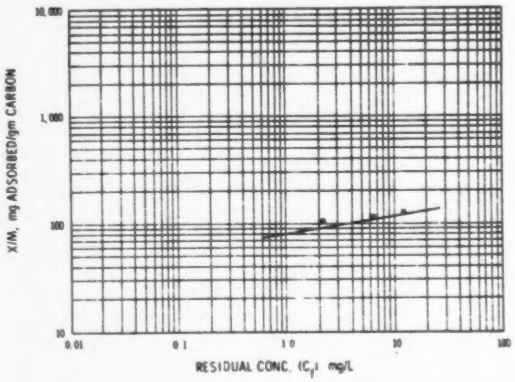
mol. wt.: 106.2 m.p., °C: -25.2 b.p. (760 torr), °C: 144
vapor pressure (32°C), torr: 10 (*o*-Xylene)
solubility in water (25°C), mg/L: Insoluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data for *p*-Xylene [2]

pH: 7.3
type of carbon: Filtrasorb-300
adsorbability: 110 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF XYLENES[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pulp, paper and paperboard mills	3	8	5	0	NA	0.15

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF XYLENES[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pulp, paper and paperboard mills	<1	400	<76	0	NA	2.3

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR XYLENES[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Trickling filters			0[d,e]	-[e]	III.5.2
Solvent extraction			97->98	<4,000	III.5.6
Activated sludge			0[d,e]	-[e]	III.5.1
Powdered activated carbon adsorption	92	1,500			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

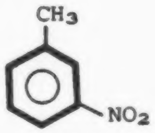
REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part II, PP. 95, 96.

2. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Nitrotoluene

Formula:



Alternate Names: Methyl nitrobenzene

CAS #: *o*, 88-72-2; *m*, 99-081; *p*, 99-99-0

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 137.1
m.p., °C: *o*, -10.6 to -4.1; *m*, 15.5; *p*, 51.3
b.p. (760 torr), °C: *o*, 222; *m*, 231; *p*, 238
vapor pressure (20°C), torr: 0.1
solubility in water (30°C), mg/L: *o*, 652; *m*, 498, *p*, 442
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: *o* and *p*, 32.5 mg COD g^{-1} dry innoculum h^{-1}; 98% removal by activated sludge at 20°C; *m*, 21.0 mg COD g^{-1} dry innoculum h^{-1}; 99% removal by activated sludge at 20°C

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF NITROTOLUENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF NITROTOLUENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR NITROTOLUENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. pp. 495, 496.

2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

Compound: Naphthenic acid

Formula: Exact composition unknown, complex mixture of normal and branched carboxylic acids, alkyl derivatives of cyclopentane and cyclohexane carboxylic acids, and cyclopentyl and cyclohexyl derivatives of carboxylic acid

Alternate Names:

CAS #: 1338-24-5

Physical, Chemical, and Biological Properties: Not available

mol. wt.: ∿180-350 m.p., °C: b.p. (760 torr), °C: 200-300 range
vapor pressure (25°C), torr:
solubility in water (25°C), mg/L:
log octanol/water partition coefficient:
Henry's law constant:
biodegradability:

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF NAPHTHENIC ACID[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF NAPHTHENIC ACID[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR NAPHTHENIC ACID[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

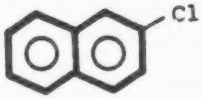
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part II, 10 pp.

Compound: 2-Chloronaphthalene

Formula:



Alternate Names: Halowax, B-Chloronaphthalene

CAS #: 91-58-7

Physical, Chemical, and Biological Properties [1]

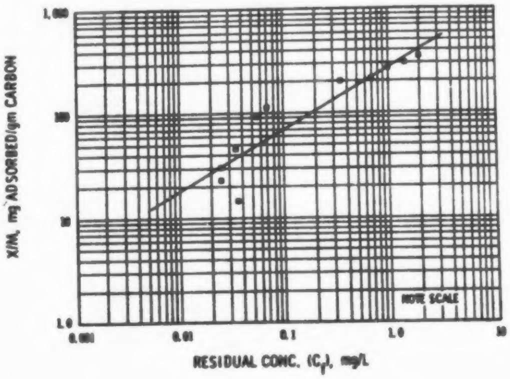
mol. wt.: 162.6 m.p., °C: 61 b.p. (760 torr), °C: 256
vapor pressure (20°C), torr: 0.017 (calculated)
solubility in water (25°C), mg/L: 6.74 (calculated)
log octanol/water partition coefficient: 4.12
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Some of the dissolved compound may be photolyzed slowly
oxidation: Probably too slow to be important
hydrolysis: Not important
volatilization: No volatilization rate has been determined, but slow volatilization has been recorded
sorption: 2-Chloronaphthalene should be adsorbed onto particulates, especially organic matter
biological processes: Bioaccumulation occurs, but is probably short-term; biodegradation and metabolization are both fairly rapid
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 5.5
type of carbon: Filgrasorb-300
adsorbability: 32mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.5



INDUSTRIAL OCCURRENCE OF 2-CHLORONAPHTHALENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.4	0	0.011	0.0015
Textile mills	NA	<10[d]	<10[d]	4.2×10^{-5}	0.29	0.018
Auto and other laundries	ND	17	1	9×10^{-7}	0.0014	0.00021
Steam electric power generating (condenser cooling system)	NA	NA	10[e]	6×10^{-8}	0.6	0.0015
Steam electric power generating (ash handling)	NA	NA	52[e]	0.0010	5.1	1.1
Iron and steel manufacturing	NA	NA	22	0	NA	4.0
Nonferrous metals manufacturing	ND	3	0.3	0	NA	0.016

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF 2-CHLORONAPHTHALENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Textile mills	NA	NA	NA	NA	NA	NA
Iron and steel mnufacturing	NA	NA	3,500	0	NA	630

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 2-CHLORONAPHTHALENE^{a,b}

Treatment process^{a}	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,^{c} %	Average achievable conc., μg/L	Removal range,^{c} %	Average achievable conc., μg/L	
Gas flotation with chemical addition (alum, polymer)			3^{d}	16^{d}	III.4.5
Filtration			0^{d,e}	-^{e}	III.4.6
Sedimentation with chemical addition (lime, polymer)			0^{d,e}	-^{e}	III.4.3
Aerated lagoons			>47^{d}	<10^{d}	III.5.3
Activated sludge	~100	<50	50^{d}	1^{d}	III.5.1
Powdered activated carbon adsorption	99	20			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

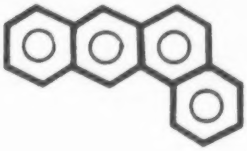
[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 37-1 - 37-8.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Benzo(a)anthracene Formula:



Alternate Names: 1,2-Benzanthracene,
Tetraphene, Naphthanthracene,
2,3-Benzophenanthrene

CAS #: 56-55-3

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 228.3 m.p., °C: 155-157 b.p. (760 torr), °C: Sublimes
vapor pressure (20°C), torr: 5×10^{-9}
solubility in water (25°C), mg/L: 0.014
log octanol/water partition coefficient: 5.61
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Photolysis to quinones is rapid, but is greatly hindered by adsorption
oxidation: Oxidation by alkyl peroxy radicals could compete with photolysis dissolved benzo(a)anthracene
hydrolysis: Not important
volatilization: Too slow to compete with sorption as a transport process
sorption: Very strong adsorption by suspended solids is the principal transport process
biological processes: Short-term bioaccumulation is accompanied by metabolization; biodegradation is the principal fate
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF BENZ(a)ANTHRACENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	35	9.2	0	0.24	0.035
Timber products processing	BDL	7,700	157[d]	0	7.2	0.013
Auto and other laundries	ND	120	120	0.00011	17	0.025
Coil coating	ND	160	33	0.0016	0.059	0.016
Foundries	ND	NA	3,300	0	22	8.9
Iron and steel manufacturing	NA	2,000	90	0	NA	16
Nonferrous metals manufacturing	ND	180	13	0	NA	70

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF BENZ(a)ANTHRACENE[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.2[d]	0	0.0053	0.00076
Timber products processing	BDL	3,400	9[e]	0	0.41	0.00077
Auto and other laundries	NA	ND	ND	-[f]	-[f]	-[f]
Foundries	<20	7,300	1,200	0	8.0	3.2
Iron and steel manufacturing	NA	470,000	34	0	NA	6.1
Nonferrous metals manufacturing	ND	6.0	0.7	0	NA	0.04

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between benz(a)anthracene and chrysene.

[e] Median, not average.

[f] Indeterminate.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BENZ(a)ANTHRACENE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers
Gravity oil separation			NA	55[d]	III.4.1
Sedimentation with chemical addition (lime, polymer)			>81[d]	<10[d]	III.4.3
Sedimentation with chemical addition (lime)			>92[d]	<10[d]	III.4.3
Activated sludge	41	2,950			III.5.1
Granular activated carbon adsorption			>93 - >97	<0.02	III.6.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

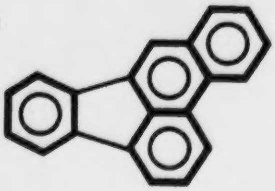
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 97-1 - 97-23.

2. Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976.

Compound: Benzo(b)fluoranthene

Formula:



Alternate Names: 2,3-Benzofluoranthene,
Benz(e)acephenanthrylene,
3,4-Benzofluoranthene, B(b)F

CAS #: 205-99-2

Physical, Chemical, and Biological Properties [1]

mol. wt.: 252.3 m.p., °C: 167-168 b.p. (760 torr), °C: Not available
vapor pressure (20°C), torr: 10^{-11} - 10^{-6}*
solubility in water (25°C), mg/L: Not available
log octanol/water partition coefficient: 6.57
Henry's law constant: Not available
biodegradability: Not available

---

*Estimated based on data for structurally similar compounds.

Probable Fate [1]

photolysis: Dissolved portion should undergo direct photolysis to quinones
oxidation: Rapid oxidation by chlorine and ozone could occur when chlorine and ozone are available in sufficient quantity
hydrolysis: Not important
volatilization: Probably too slow to compete with adsorption as a transport process
sorption: Very strong adsorption onto suspended solids is the principal transport process
biological processes: Short-term bioaccumulation accompanied by metabolization; biodegradation is the principal fate
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF BENZO(b)FLUORANTHENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining[d]	ND	12	3.6	0	0.095	0.014
Textile mills	NA	<10[e]	<10[e]	4.2×10^{-5}	0.29	0.018
Timber products processing	BDL	1,680	87[f]	0	4.0	0.0075
Foundries	ND	36	14	0	0.094	0.038
Coil coating	ND	35	18	0.0009	0.032	0.0086
Nonferrous metals manufacturing	ND	260	19	0	NA	1.0
Iron & steel manufacturing	NA	200	28	0	NA	5.0

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between benzo(b)fluoranthene and benzo(k)fluoranthene.

[e] One sample.

[f] Median, not average.

INDUSTRIAL OCCURRENCE OF BENZO(b)FLUORANTHENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Timber products processing	BDL	2,500	57[e]	0	0.41	0.00077
Textile mills	NA	NA	NA	NA	NA	NA
Iron and steel manufacturing	NA	37	12	0	NA	2.2
Nonferrous metals manufacturing	ND	12	0.6	0	NA	0.032

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BENZO(b)FLUORANTHENE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers
Sedimentation			83[d]	6[d]	III.4.2
Aerated lagoons			0.4	97	III.5.3
Powdered activated carbon adsorption	68	0.040			III.6.2
Ozonation			>80[d]	<0.02[d]	III.6.14

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

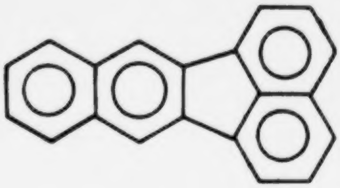
[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 97-1 - 97-23.

Compound: Benzo(k)fluoranthene Formula:



Alternate Names: 11, 12-Benzofluoranthene, B(k)F

CAS #: 207-08-9

Physical, Chemical, and Biological Properties [1,2]

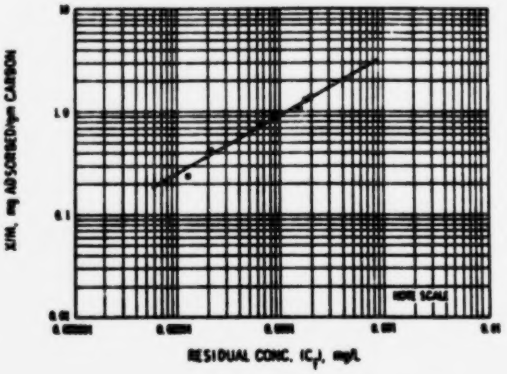
mol. wt.: 252.3 m.p., °C: 217 b.p. (760 torr), °C: 480
vapor pressure (20°C), torr: 9.59×10^{-11}
solubility in water (25°C), mg/L: Not available
log octanol/water partition coefficient: 6.84
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Dissolved portion may undergo photolysis to quinones
oxidation: If chlorine and/or ozone is present in sufficient quantity, rapid oxidation should occur
hydrolysis: Not important
volatilization: Probably too slow to compete with adsorption as a transport process; rate uncertain
sorption: Very strongly sorbed onto suspended solids; dominant transport process
biological processes: Bioaccumulation (short-term) accompanied by metabolization; biodegradation (microbial) dominant fate
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 7.1
type of carbon: Filtrasorb-300
adsorbability: 50 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF BENZO(k)FLUORANTHENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining[d]	ND	12	3.6	0	0.095	0.014
Textile mills[e]	NA	10[e]	<10[e]	4.2×10^{-5}	0.29	0.018
Timber products processing	BDL	3,900	27[f]	0	1.2	0.0023
Auto and other laundries	ND	120	120	0.00010	0.17	0.025
Foundries	ND	NA	6	0	0.040	0.016
Coil coating	ND	35	18	0.0009	0.032	0.0086
Iron & steel manufacturing	NA	360	40	0	NA	7.2
Nonferrous metals manufacturing	ND	210	20	0	NA	1.0

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between benzo(b)fluoranthene and benzo(k)fluoranthene.

[e] One sample.

[f] Median, not average.

INDUSTRIAL OCCURRENCE OF BENZO(k)FLUORANTHENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Timber products processing	BDL	210	37[e]	0	1.7	0.0032
Textile mills	NA	NA	NA	NA	NA	NA
Auto and other laundries	NA	ND	ND	-[d]	-[d]	-[d]
Nonferrous metals manufacturing	ND	12	0.6	0	NA	0.032
Iron and steel manufacturing	NA	37	12	0	NA	2.2

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BENZO(k)FLUORANTHENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	150	III.4.1
Filtration			0[d,e]	-[e]	III.4.6
Sedimentation			>57 - >97	<5	III.4.2
Granular activated carbon adsorption			>80[d]	<0.02[d]	III.6.1
Powdered activated carbon adsorption	97	0.013			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

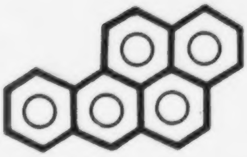
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 97-1 - 97-23.

2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-180.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Benzo(a)pyrene

Formula:



Alternate Names: 3,4-Benzopyrene

CAS #: 50-32-8

Physical, Chemical, and Biological Properties [1]

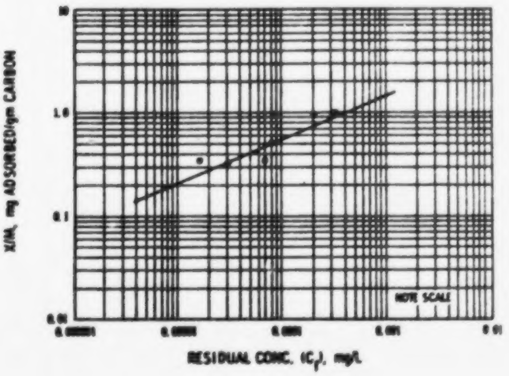
mol. wt.: 252.3   m.p., °C: 179   b.p. (10 torr), °C: 310-312
vapor pressure (25°C), torr: 5×10^{-9}
solubility in water (25°C), mg/L: 0.0038
log octanol/water partition coefficient: 6.04
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Dissolved portion should undergo rapid photolysis to quinones
oxidation: Oxidation by chlorine and/or ozone could account for a small portion of the dissolved compound
hydrolysis: Not important
volatilization: Probably too slow to compete with adsorption as a transport process, slow
sorption: Very strong adsorption onto suspended solids is the dominant transport process
biological processes: Bioaccumulation is short-term; metabolization and microbial degradation principal fates
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 7.1
type of carbon: Filtrasorb-300
adsorbability: 270 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF BENZO(a)PYRENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	12	4.6	0	0.12	0.017
Timber products processing	BDL	2,700	420[d]	0	19	0.036
Petroleum refining	NA	NA	NA	NA	NA	NA
Auto and other laundries	ND	120	120	0.00011	0.17	0.025
Foundries	ND	57	16	0	0.11	0.043
Coil coating	ND	<10	<10	<0.0005	<0.018	<0.0048
Nonferrous metals manufacturing	ND	570	17	0	NA	0.90
Iron & steel manufacturing	NA	510	21	0	NA	3.8

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF BENZO(a)PYRENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Timber products processing	BDL	290	15[e]	0	0.69	0.0013
Petroleum refining[f]	1.3	2.9	2.1	0	0.19	0.012
Auto and other laundries	NA	17[g]	17[g]	1.5×10^{-5}	0.024	0.0036
Iron and steel manufacturing	NA	130	9	0	NA	1.62
Nonferrous metals manufacturing	ND	9.0	4.2	0	NA	0.22
Foundries	<20[g]	<20[g]	<20[g]	0	0.13	0.054

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] Median, not average.

[f] Analytical method did not distinguish between benzo(a)pyrene and perylene.

[g] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BENZO(a)PYRENE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	15.5	III.4.1
Filtration			0[e]	-[e]	III.4.6
Sedimentation			>70 - 98	<5.3	III.4.2
Sedimentation with chemical addition (lime, polymer)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (lime)			0[d,e]	-[e]	III.4.3
Aerated lagoons			33[d]	2[e]	III.5.3
Powdered activated carbon adsorption	98	0.030			III.6.2
Ozonation			>90[d]	<0.02[d]	III.6.14

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

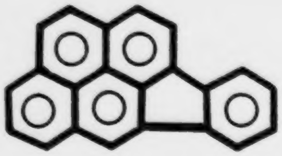
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 98-1 - 98-27.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Indeno(1,2,3-cd)pyrene

Formula:



Alternate Names: 2,3-*o*-Phenylenepyrene,
IP

CAS #: 193-39-5

Physical, Chemical, and Biological Properties [1]

mol. wt.: 276.3 m.p., °C: 162-164 b.p. (760 torr), °C: Not available
vapor pressure (20°C), torr: $\sim 10^{-10}$ (calculated)
solubility in water (25°C), mg/L: Not available
log octanol/water partition coefficient: 7.66
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Insufficient data, but at best only a small portion of the compound would be available in dissolved form for photolysis
oxidation: Rapid oxidation by chlorine and/or ozone may compete for dissolved compound
hydrolysis: Not important
volatilization: Probably too slow to be important; rate uncertain
sorption: Very strong adsorption onto suspended solids should be the dominant transport process
biological processes: Bioaccumulation is short-term; metabolization and microbial biodegradation are the principal fates
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF INDENO(1,2,3-cd)PYRENE[a]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<2.1	0	0.056	0.0079
Timber products processing	BDL	5,500	130[d]	0	6.0	0.011
Iron and steel manufacturing	NA	NA	7	0	NA	
Nonferrous metals manufacturing	ND	350	18	0	NA	

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF INDENO(1,2,3-cd)PYRENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	6.3	0.4	0	0.011	0.0015
Timber products processing	BDL	110	40[d]	0	1.8	0.0034
Iron and steel manufacturing	NA	NA	8	0	NA	1.4
Nonferrous metals manufacturing	ND	8	0.4	0	NA	0.02

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR INDENO(1,2,3-cd)PYRENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gravity oil separation			NA	40[d]	III.4.1
Activated sludge			>99[d]	<0.02[d]	III.5.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

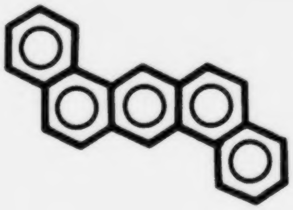
[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 98-1 - 98-27.

Compound: Dibenzo(a,h)anthracene

Formula:



Alternate Names: DB(a,h)A, 1,2,5,6-Dibenzanthracene, DBA

CAS #: 53-70-3

Physical, Chemical, and Biological Properties [1]

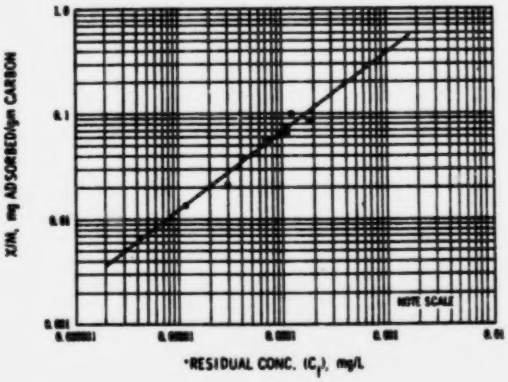
mol. wt.: 278.4 m.p., °C: 270 b.p. (760 torr), °C: Sublimes
vapor pressure (20°C), torr: $\sim 10^{-10}$ (calculated)
solubility in water (25°C), mg/L: 0.0005
log octanol/water partition coefficient: 5.97
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: The dissolved portion of the compound may undergo rapid photolysis to quinones
oxidation: Rapid oxidation by chlorine and/or ozone may compete for dissolved DBA
hydrolysis: Not important
volatilization: Probably too slow to be important; rate uncertain
sorption: Strong adsorption by suspended solids, especially organic particulates, should be the principal transport process
biological processes: Bioaccumulation is short-term; metabolization and microbial biodegradation are the principal fates
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 7.1
type of carbon: Filtrasorb-300
adsorbability: 130 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF DIBENZ(ah)ANTHRACENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1.7	0	0.045	0.0064
Timber products processing	BDL	430	NA	0	9.9	0.018
Iron and steel manufacturing	NA	16	8	0	NA	1.4
Nonferrous metals manufacturing	ND	110	8.2	0	NA	0.43

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF DIBENZ(ah)ANTHRACENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	8	0.5	0	0.013	0.0019
Timber products processing	NA	BDL	BDL	-[d]	-[d]	-[d]
Nonferrous metals manufacturing	ND	8	0.6	0	NA	0.032
Iron and steel manufacturing	NA	NA	8	0	NA	1.44

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DIBENZ(ah)ANTHRACENE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

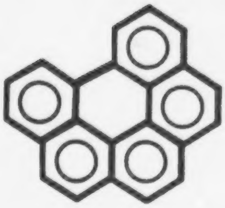
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 98-1 - 98-27.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Benzo(ghi)perylene **Formula:**



Alternate Names: 1,12-Benzoperylene

CAS #: 191-24-2

Physical, Chemical, and Biological Properties [1]

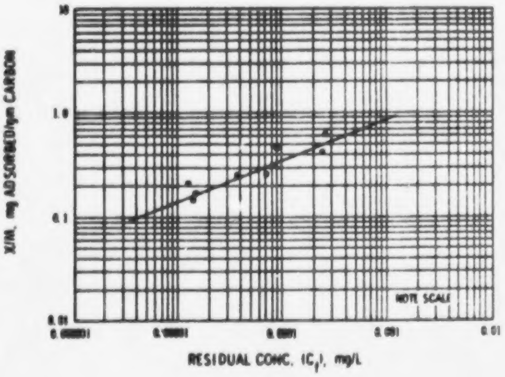
mol. wt.: 276 m.p., °C: 222 b.p. (760 torr), °C: Not available
vapor pressure (20°C), torr: $\sim 10^{-10}$ (calculated)
solubility in water (25°C), mg/L: 0.00026
log octanol/water partition coefficient: 7.23
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: The dissolved portion could undergo rapid photolysis, but very little of the compound is present in dissolved form
oxidation: Oxidation by chlorine and/or ozone could occur if enough chlorine or ozone is present; relatively unimportant
hydrolysis: Not important
volatilization: Probably too slow to compete with adsorption as a transport process; rate uncertain
sorption: Very strong adsorption onto suspended solids, especially organic matter, should be the dominant transport process
biological processes: Bioaccumulation is short-term; metabolization and microbial biodegradation are the principal fates
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 7.0
type of carbon used: Filtrasorb-300
adsorbability: 840 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF BENZO(ghi)PERYLENE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	12	3.6	0	0.095	0.014
Timber products processing	BDL	315	6[d]	0	0.28	0.00052
Coil coating	ND	<10	<10	<0.0005	<0.018	<0.0048
Nonferrous metals manufacturing	ND	150	12	0	NA	0.64
Iron and steel manufacturing	NA	NA	16	0	NA	2.9

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF BENZO(ghi)PERYLENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.2	0	0.0053	0.00076
Timber products processing	BDL	63	2[d]	0	0.092	0.00017
Iron and steel manufacturing	NA	NA	6	0	NA	1.1
Nonferrous metals manufacturing	ND	11	0.2	0	NA	0.011

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BENZO(ghi)PERYLENE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., μg/L	Volume III references, Section numbers
Gravity oil separation			NA	550	III.4.1
Sedimentation			>17[d]	<10[d]	III.4.2
Powdered activated carbon adsorption	83	0.015			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

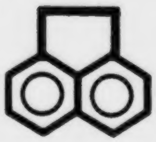
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 98-1 - 98-27.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Acenaphthene

Formula:



Alternate Names: 1,8-Ethylenenaphthalene

CAS #: 83-32-9

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 154.2 m.p., °C: 96 b.p. (760 torr), °C: 279
vapor pressure (20°C), torr: $10^{-3} - 10^{-2}$*
solubility in water (25°C), mg/L: 3.42
log octanol/water partition coefficient: 4.33
Henry's law constant: 0.241×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

---

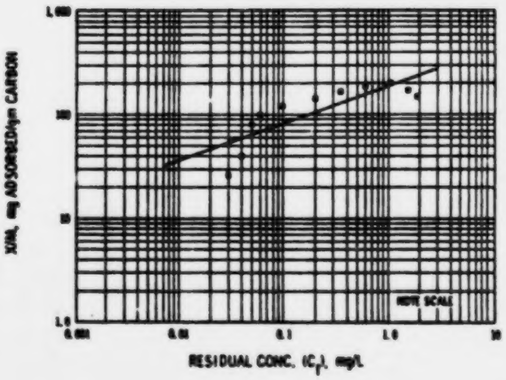
*Estimated, based on data for structurally similar compounds

Probable Fate [1]

photolysis: Photolysis should be an important fate in view of the relatively high solubility and the strong absorption above 300 nm
oxidation: Rapid oxidation by chlorine and ozone requires high concentrations of Cl or O_3
hydrolysis: Not important
volatilization: Cannot compete with adsorption as a transport process
sorption: Adsorption onto suspended solids, especially organic matter, should be dominant transport process
biological processes: Bioaccumulation is short-term; metabolization and biodegradation are principal fates
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 47 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF ACENAPHTHENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1.9	0	0.050	0.0072
Textile mills	NA	12	8.7[d]	3.6×10^{-5}	0.25	0.016
Timber products processing	BDL	55,000	170[d]	0	7.8	0.015
Petroleum refining	37	522	280[d]	0	26	1.6
Pharmaceutical manufacturing	ND	100	12	0	0.082	0.011
Foundries	ND	200	21	0	0.014	0.057
Leather tanning and finishing	ND	NA	5	0	NA	0.0075
Nonferrous metals manufacturing	ND	100	7.4	0	NA	0.39
Iron and steel manufacturing	NA	53	9	0	NA	1.6

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[c] Median, not average.

INDUSTRIAL OCCURRENCE OF ACENAPHTHENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Textile mills	NA	0.5[e]	0.5[e]	2.0×10^{-6}	0.014	0.0009
Timber products processing	BDL	18,000	90[f]	0	4.1	0.0077
Petroleum refining	NA	0.6[e]	0.6[e]	0	0.056	0.0035
Pharmaceutical manufacturing	ND	ND	ND	-[d]	-[d]	-[d]
Foundries	<10	39	21	0	0.14	0.057
Iron and steel manufacturing	NA	NA	11	0	NA	2.0
Nonferrous metals manufacturing	ND	36	5.1	0	NA	0.27

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] One sample.

[f] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ACENAPHTHENE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	910	III.4.1
Filtration			73[d]	0.6[d]	III.4.6
Aerated lagoons			0[d,e]	-[e] -	III.5.6
Activated sludge	~100	<50	76 - >99	<1.5	III.5.1
Granular activated carbon adsorption			>93[d]	<0.04[d]	III.6.1
Powdered activated carbon adsorption	99	30			III.6.2
Reverse osmosis			76 - 99	1.5	III.6.9

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 95-1 - 95-20.

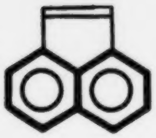
2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-81.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Acenaphthylene

Formula:



Alternate Names: None

CAS #: 208-96-8

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 152.2   m.p., °C: 92   b.p. (760 torr), °C: 265-275 (partial decomposition)

vapor pressure (20°C), torr: 10^{-3} - 10^{-2}*
solubility in water (25°C), mg/L: 3.93
log octanol/water partition coefficient: 4.07
Henry's law constant: 0.114×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

---

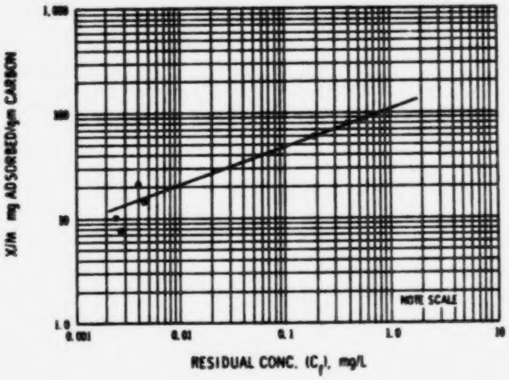
*Estimated, based on data for structurally similar compounds

Probable Fate [1]

photolysis: Rapid photolysis of dissolved acenaphthylene could be an important fate; data inconclusive
oxidation: No data on acenaphthylene, but in the presence of ozone and/or chlorine in large amounts, oxidation may occur
hydrolysis: Not important
volatilization: Probably too slow to compete with adsorption as a transport process, rate uncertain
sorption: Acenaphthylene should be adsorbed onto suspended solids, especially organic particulates
biological processes: Bioaccumulation is short-term; metabolization and biodegradation are the most important fates
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 78 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



IDUSTRIAL OCCURRENCE OF ACENAPHTHYLENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	8	1	0	0.026	0.0038
Timber products processing	BDL	2,060	930[d]	0	43	0.080
Petroleum refining	4	87	46[d]	0	4.3	0.27
Leather tanning and finishing	ND	NA	2	0	NA	0.003
Coal coating	<10	<10	<10	<0.0005	<0.018	<0.0048
Foundries	ND	62	15	0	0.10	0.040
Iron and steel manufacturing	NA	6,400	290	0	NA	52
Nonferrous metals manufacturing	ND	120	8.2	0	NA	0.43

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF ACENAPHTHYLENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Timber products processing	BDL	190	4[e]	0	0.18	0.00034
Petroleum refining	NA	NA	NA	NA	NA	NA
Nonferrous metals manufacturing	ND	36	1.3	0	NA	0.069
Iron and steel manufacturing	NA	1,600	28	0	NA	5.0
Foundries	<10	500	69	0	0.46	0.19

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ACENAPHTHYLENE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	40	III.4.1
Sedimentation			>17[d]	<10[d]	III.4.2
Sedimentation with chemical addition (lime, polymer)			0[d,e]	-[e]	III.4.3
Aerated lagoons			0[d,e]	-[e]	III.5.3
Activated sludge	~100	<50	0[d,e]	-[e]	III.5.1
Powdered activated carbon adsorption	~100	2.8			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

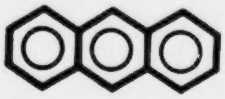
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 95-1 - 95-20.

2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-81.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Anthracene **Formula:**



Alternate Names: Paranaphthalene, Green oil,
Tetra Olive NZG

CAS #: 120-12-7

Physical, Chemical, and Biological Properties [1, 2]

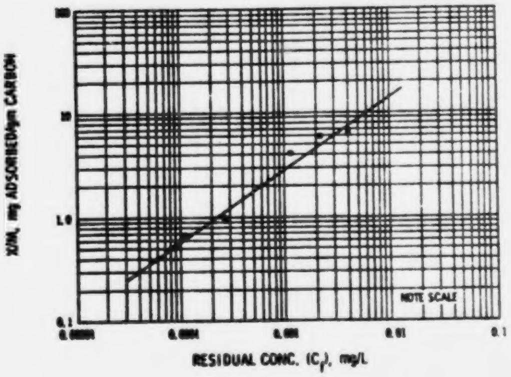
mol. wt.: 178.2 m.p., °C: 216 b.p. (760 torr), °C: 342
vapor pressure (20°C), torr: 1.95×10^{-4}
solubility in water (25°C), mg/L: 0.073
log octanol/water partition coefficient: 4.45
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Rapid photolysis occurs only for dissolved portion; thus, increased adsorption greatly decreases photolysis
oxidation: Ozone and chlorine in sufficient quantities can oxidize dissolved anthracene
hydrolysis: Not important
volatilization: Volatilization is hindered by adsorption and is significant only in shallow, clear, well mixed streams
sorption: Adsorption by suspended solids and sediments is the primary transport process
biological processes: Short-term bioaccumulation; metabolization and biodegradation are the ultimate fates
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 24 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF ANTHRACENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining[d]	ND	132	23	0	16	0.087
Textile mills	NA	0.1[e]	0.1[e]	4.2×10^{-7}	0.0029	0.00018
Petroleum refining[d]	46	1,100	170[f]	0	NA	NA
Timber products processing	NA	NA	NA	NA	NA	NA
Auto and other laundries[g]	ND	470	23	2.1×10^{-5}	0.032	0.0048
Pharmaceutical manufacturing	ND	7	1.8	0	0.012	0.0017
Coil coating	ND	1,400	28	0.0014	0.050	0.013
Foundries	ND	470	64	0	0.43	0.17
Leather tanning and finishing[g]	ND	140	62	0	NA	0.093
Nonferrous metals manufacturing	ND	3,000	43	0	NA	2.2
Iron and steel manufacturing	NA	2,800	91	0	NA	16

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between anthracene and phenanthrene.

[e] One sample.

[f] Median, not average.

[g] Analytical method did not distinguish between anthracene/phenanthrene.

INDUSTRIAL OCCURRENCE OF ANTHRACENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining[d]	ND	<10	<1.4	0	0.037	0.0053
Textile mills	NA	4.4[e]	4.4[e]	1.8×10^{-5}	1.3	0.0079
Timber products processing	BDL	37,000	59[f]	0	2.7	0.0051
Petroleum refining[d]	Trace	<10	<0.8[f]	0	0.074	0.0046
Auto and other laundries[g]	2	12	5.0	4.5×10^{-6}	0.007	0.001
Pharmaceutical manufacturing	ND	ND	ND	ND	ND	ND
Foundries	<4	3,200	480	0	3.2	1.3
Iron and steel manufacturing	NA	2,300	59	0	NA	11
Nonferrous metals manufacturing	ND	140	6.6	0	NA	0.35
Leather tanning and finishing	ND[d]	<10[d]	4.1[d]	0	NA	0.0062

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between anthracene and phenanthrene.

[e] One sample.

[f] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ANTHRACENE[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	3^{d}	III.4.1
Gas flotation			$45^{d,f}$	$\sim 600^{d,f}$	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			$83^{d,f}$	$66^{d,f}$	III.4.5
Gas flotation with chemical addition (polymer)			$0^{d,e,f}$	$-^{e,f}$	III.4.5
Gas flotation with chemical addition (alum, polymer)			$0^{d,e,f}$	$-^{e,f}$	III.4.5
Filtration			$40\text{-}70^{f}$	400^{f}	III.4.6
Sedimentation			$55\text{-}92^{f}$	$<14^{f}$	III.4.2
Sedimentation with chemical addition (lime, polymer)			$0^{d,e,f}$	$-^{e,f}$	III.4.3
Sedimentation with chemical addition (polymer)			$0^{d,e,f}$	$-^{e,f}$	III.4.3
Sedimentation with chemical addition (alum)			$0^{d,e,f}$	$-^{e,f}$	III.4.3
Ozonation			$48\text{->}97^{f}$	0.2^{f}	III.6.14
Activated sludge	92	400	$57\text{->}97^{f}$	$<2.5^{f}$	III.5.1
Granular activated carbon adsorption			$>63\text{->}97^{f}$	0.12^{f}	III.6.1
Powdered activated carbon adsorption	98	0.09			III.6.2
Reverse osmosis			$77^{d,f}$	$0.7^{d,f}$	III.6.9

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

[f] Analytical method did not distinguish between anthracene and phenanthrene.

REFERENCES

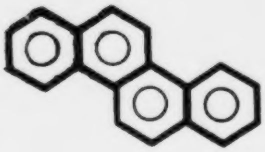
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 96-1 - 96-20.

2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-119.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Chrysene

Formula:



Alternate Names: 1,2-Benzophenanthrene,
Benzo(a)phenanthrene,
1,2,5,6-Dibenzonaphthalene

CAS #: 218-01-9

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 228.3 m.p., °C: 256 b.p. (760 torr), °C: 448
vapor pressure (20°C), torr: 10^{-11} - 10^{-6}*
solubility in water (25°C), mg/L: 0.002
log octanol/water partition coefficient: 5.61
Henry's law constant: Not available
biodegradability: Not available

---

*Estimated, based on data for structurally similar compounds.

Probable Fate [1]

photolysis: Very little specific data, but photolysis may claim some dissolved chrysene
oxidation: Chlorine and/or ozone in sufficient quantities may oxidize dissolved chrysene
hydrolysis: Not important
volatilization: Probably too slow to compete with adsorption as a transport process
sorption: Adsorption onto suspended solids and sediment is the dominant transport process
biological processes: Short-term bioaccumulation; metabolization and biodegradation are the principal fates
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF CHRYSENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining[d]	ND	35	9.2	0	0.24	0.035
Timber products processing	BDL	4,700	98[e]	0	4.5	0.0084
Coil coating	ND	160	17	0.00085	0.031	0.008
Foundries	57	13,000	1,100	0	7.4	3.0
Iron and steel manufacturing	NA	2,200	94	0	NA	17
Nonferrous metals manufacturing	ND	10,000	160	0	NA	8.5

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between benz(a)anthracene and chrysene.

[e] Median, not average.

INDUSTRIAL OCCURRENCE OF CHRYSENE[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining[d]	ND	<3.3	<0.2	0	0.0053	0.0076
Timber products processing	BDL	19,000	BDL	-[e]	-[e]	-[e]
Petroleum refining	0.3	1.4	0.8[f]	0	0.074	0.0046
Foundries	13	<20	17	0	0.11	0.046
Iron and steel manufacturing	NA	530	18	0	NA	3.2
Nonferrous metals manufacturing	ND	140	3.8	0	NA	0.20

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between benz(a)anthracene and chrysene.

[e] Mean pollutant concentration below detection limit.

[f] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CHRYSENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	11	III.4.1
Sedimentation			$0^{d,e}$	$-^{e}$	III.4.2
Sedimentation with chemical addition (lime, polymer)			99^{d}	10^{d}	III.4.3
Sedimentation with chemical addition (lime)			$>92^{d}$	$<10^{d}$	III.4.3
Activated sludge	65	1,750			III.5.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

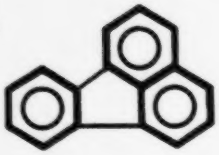
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 97-1 - 97-23.

2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-247.

Compound: Fluoranthene

Formula:



Alternate Names: 1,2-Benzacenaphthlene
Benzo(j,k) fluorene,
Idryl

CAS #: 206-44-0

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 202.3   m.p., °C: 111   b.p. (760 torr), °C: 375
vapor pressure (20°C), torr: $10^{-6} - 10^{-4}$*
solubility in water (25°C), mg/L: 0.26
log octanol/water partition coefficient: 5.33
Henry's law constant: Not available
biodegradability: Not available

---

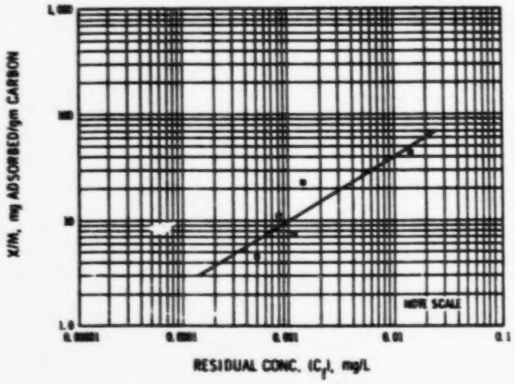
*Estimated, based on data for structurally similar compounds.

Probable Fate [1]

photolysis: Insufficient data, but photolysis may be very important
oxidation: Chlorine and/or ozone in sufficient quantities may oxidize fluoranthene
hydrolysis: Not important
volatilization: Not an important transport process
sorption: Adsorption onto suspended solids and sediments is probably the dominant transport process
biological processes: Short-term bioaccumulation; biodegradation is a very important fate
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 14 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF FLUORANTHENE[a,b]

Industry	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	16	4	0	0.11	0.015
Timber products processing	BDL	35,000	1,600[d]	0	74	0.14
Petroleum refining	NA	270[e]	270[e]	0	25	1.6
Auto and other laundries	ND	14	7	6.3×10^{-6}	0.0098	0.0015
Coil coating	ND	130	20	0.001	0.028	0.0096
Foundries	ND	390	40	0	0.27	0.11
Leather tanning and finishing	ND	NA	0.3	0	NA	0.00045
Iron and steel manufacturing	NA	3,100	110	0	NA	20
Nonferrous metals manufacturing	ND	3,000	55	0	NA	2.9

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] One sample.

INDUSTRIAL OCCURRENCE OF FLUORANTHENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<0.4	0	0.011	0.0015
Timber products processing	BDL	17,000	110[d]	0	5.1	0.0095
Petroleum refining	NA	NA	BDL	-[e]	-[e]	-[e]
Auto and other laundries	ND	0.4	0.2	2×10^{-7}	0.00028	4.2×10^{-5}
Foundries	6	97	35	0	0.23	0.095
Iron and steel manufacturing	ND	860	39	0	NA	7.0
Nonferrous metals manufacturing	ND	200	13	0	NA	0.69

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR FLUORANTHENE^{a,b}

Treatment process^{a}	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,^{c} %	Average achievable conc., μg/L	Removal range,^{c} %	Average achievable conc., μg/L	
Gravity oil separation			NA	60	III.4.1
Gas flotation with chemical addition (polymer)			$0^{d,e}$	$-^{e}$	III.4.5
Filtration			29-50	0.11	III.4.6
Sedimentation			17->64	<17	III.4.2
Sedimentation with chemical addition (lime, polymer)			$>97^{d}$	$<10^{d}$	III.4.3
Ozonation			50^{d}	0.1^{d}	III.6.14
Activated sludge	~100	<50	$0^{d,e}$	$-^{e}$	III.5.1
Granular activated carbon adsorption			>82->90	<0.02	III.6.1
Powdered activated carbon adsorption	99	0.5			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

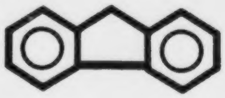
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 96-1 - 96-20.

2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-306.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Fluorene

Formula:



Alternate Names: 2,3-Benzidene,
Diphenylenemethane

CAS #: 86-73-7

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 166.2
m.p., °C: 116-117
b.p. (760 torr), °C: 293-295 (slight decomposition)

vapor pressure (20°C), torr: 10^{-3} - 10^{-2}*
solubility in water (25°C), mg/L: 1.98
log octanol/water partition coefficient: 4.18
Henry's law constant: 0.117 x 10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

---

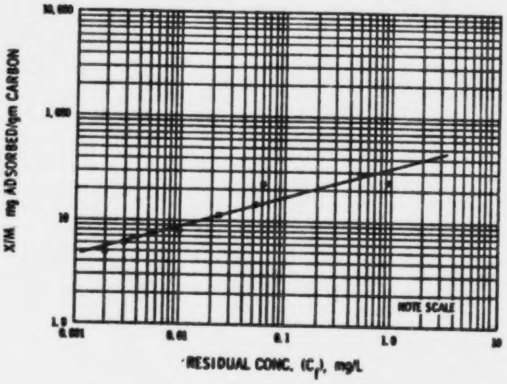
*Estimated, based on data for structurally similar compounds

Probable Fate [1]

photolysis: Inconclusive data; photolysis may be important, but is probably impeded by adsorption
oxidation: Chlorine and/or ozone in sufficient quantities may oxidize fluorene
hydrolysis: Not important
volatilization: Probably not an important transport process
sorption: Adsorption onto particles, biota, and sediments is probably the dominant transport process
biological processes: Bioaccumulation is short-term; metabolization and biodegradation are very important fates
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 27 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF FLUORENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	47	8	0	0.21	0.030
Textile mills	NA	15	NA	–[d]	–[d]	–[d]
Timber products processing	BDL	48,000	2,300[e]	0	100	0.20
Petroleum refining	NA	270[f]	270[f]	0	25	1.6
Pharmaceutical manufacturing	ND	14	3.5	0	0.024	0.0032
Foundries	ND	800	66	0	0.44	0.18
Coil coating	ND	300	17	0.00085	0.031	0.032
Nonferrous metals manufacturing	ND	94	5	0	NA	0.27
Iron and steel manufacturing	NA	2,500	85	0	NA	15

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] Median, not average.

[f] One sample.

INDUSTRIAL OCCURRENCE OF FLUORENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Timber products processing	BDL	16,000	36[e]	0	1.6	0.0031
Petroleum refining	NA	NA	NA	NA	NA	NA
Textile mills	NA	NA	NA	NA	NA	NA
Pharmaceutical manufacturing	ND	ND	ND	-[d]	-[d]	-[d]
Foundries	5	10,000	1,300	0	8.7	3.5
Iron and steel manufacturing	NA	500	17	0	NA	3.1
Nonferrous metals manufacturing	ND	100	8.7	0	NA	0.46

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

dian, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR FLUORENE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers
Gravity oil separation			NA	140	III.4.1
Filtration			$0^{d,e}$	$-^{e}$	III.4.6
Sedimentation			$>79^{d}$	$<10^{d}$	III.4.2
Sedimentation with chemical addition (lime, polymer)			50->99	<7.5	III.4.3
Ozonation			67^{d}	0.1^{d}	III.6.14
Activated sludge	82	900	>99	<0.02	III.5.1
Powdered activated carbon adsorption	~100	2			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

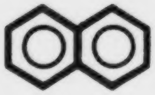
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 95-1 - 95-20.

2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-306.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Naphthalene **Formula:**



Alternate Names: Moth balls, Tar Camphor, Naphthene

CAS #: 91-20-3

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 128.2 m.p., °C: 80.6 b.p. (760 torr), °C: 218 (starts to sublime above melting point)

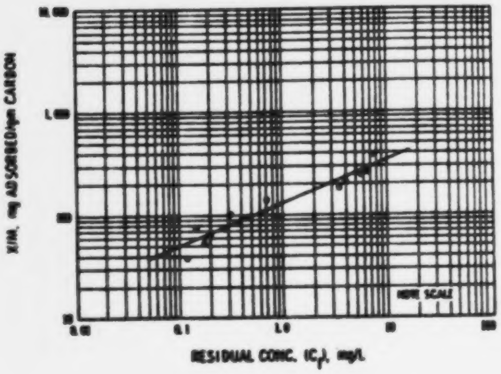
vapor pressure (20°C), torr: 0.0492
solubility in water (25°C), mg/L: 34.4
log octanol/water partition coefficient: 3.37
Henry's law constant: Not available
biodegradability: Readily degraded in static biological test using acclimated seed from an activated sludge plant; reduced from 2 ppm to nondetectable during 7-day test

Probable Fate [1]

photolysis: Relatively high solubility could make photooxidation an important fate; data inconclusive
oxidation: Chlorine and/or ozone in sufficient quantities may oxidize naphthalene
hydrolysis: Not important
volatilization: Rate uncertain; could be very important
sorption: Relatively low partition coefficient makes adsorption less dominant but sorption is still a competitive transport process
biological processes: Short-term bioaccumulation; biodegradation and metabolization are the ultimate fates
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 5.6
type of carbon: Filtrasorb-300
adsorbability: 68 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.6



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF NAPHTHALENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	402	57	0	1.5	0.21
Textile mills	NA	110	44[d]	0.00018	1.3	0.079
Timber products processing	BDL	45,000	3,500[d]	0	160	0.30
Petroleum refining	∿68	∿1,000	∿400[d]	0	∿37	∿2.3
Paint and ink formulation	ND	18,000	1,500	0	0.069	0.0024
Pulp, paper and paperboard mills	NA	NA	NA	NA	NA	NA
Auto and other laundries	ND	4,800	240	0.00022	0.34	0.050
Pharmaceutical manufacturing	ND	14	2.8	0	0.019	0.0026
Coil coating	ND	35	<10	<0.0005	<0.018	<0.005
Foundries	ND	160	27	0	0.18	0.073
Leather tanning and finishing	ND	67	26	0	NA	0.039
Nonferrous metals manufacturing	ND	5,000	110	0	NA	5.8
Iron and steel manufacturing	NA	29,000	2,300	0	NA	414

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

INDUSTRIAL OCCURRENCE OF NAPHTHALENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<0.6	0	0.016	0.0023
Textile mills	NA	255	22[d]	9.2×10^{-5}	0.63	0.040
Petroleum refining	NA	0.1[e]	0.1[e]	0	0.0093	0.00058
Timber products processing	NA	NA	NA	NA	NA	NA
Paint and ink formulation	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	NA	6[e]	6[e]	0	NA	0.18
Auto and other laundries	0.9	520	200	0.00018	0.28	0.042
Pharmaceutical manufacturing	ND	7	1.4	0	0.0095	0.0013
Foundries	3	270	44	0	0.29	0.12
Iron and steel manufacturing	NA	5,900	200	0	NA	36
Leather tanning and finishing	ND	15	4.3	0	NA	0.0064
Nonferrous metals manufacturing	ND	930	17	0	NA	0.90

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR NAPHTHALENE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., μg/L	Volume III references, Section numbers
Gravity oil separation			NA	410	III.4.1
Gas flotation			~18-36	~380	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			54-82	700	III.4.5
Gas flotation with chemical addition (polymer)			>65->96		[illegible]
Gas flotation with chemical addition (alum, polymer)			52	11	III.4.5
Filtration			>78-86	<5.8	III.4.6
Sedimentation			>50->98	<22	III.4.2
Sedimentation with chemical addition (alum, lime)			70[d]	16[d]	III.4.3
Sedimentation with chemical addition (lime, polymer)			49-98	6.5	III.4.3
Tertiary polishing lagoons			>82[d]	<10[d]	III.5.3
Aerated lagoons			>28->58	<5.5	III.5.3
Trickling filters			0[d,e]	-[e]	III.5.2
Activated sludge	~100	<50	66->99	17	III.5.1
Powdered activated carbon adsorption	99	120	>96[d]	<10[d]	III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 95-1 - 95-20.

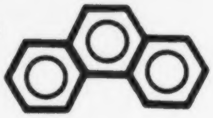
2. Fochtman, E. G., and W. Eisenberg. Treatability of Carcinogenic and other Hazardous Organic Compounds. Illinois Institute of Technology Research Institute, Chicago, Illinois. 58 pp.

3. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-381.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Phenanthrene

Formula:



Alternate Names: Phenanthrin

CAS #: 85-01-8

Physical, Chemical, and Biological Properties [1, 2]

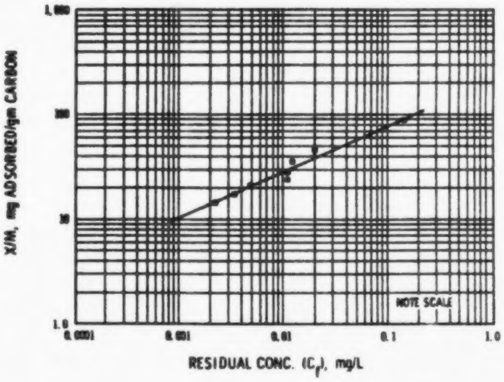
mol. wt.: 178.2   m.p., °C: 101   b.p. (760 torr), °C: 340
vapor pressure (20°C), torr: 6.8×10^{-4}
solubility in water (25°C), mg/L: 1.29
log octanol/water partition coefficient: 4.46
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Data inconclusive; photolysis is probably greatly hindered by strong adsorption
oxidation: Chlorine and/or ozone in sufficient quantities may oxidize phenanthrene
hydrolysis: Not important
volatilization: Probably not an important transport process
sorption: Probably the dominant transport process; organic particulates preferred
biological processes: Short-term bioaccumulation; metabolization and biodegradation are the principal fates
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 42 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF PHENANTHRENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Timber products processing	BDL	39,000	3,800[d]	0	170	0.33
Petroleum refining	NA	NA	NA	NA	NA	NA
Auto and other laundries[e]	ND	470	28	2.1×10^{-5}	0.032	0.0048
Pharmaceutical manufacturing	ND	7	1.8	0	0.012	0.0016
Coil coating	ND	1,400	28	0.0014	0.050	0.013
Foundries	ND	470	63	0	0.42	0.11
Leather tanning and finishing	ND	140	62	0	NA	0.093
Nonferrous metals manufacturing	ND	3,000	46	0	NA	2.4
Iron and steel manufacturing	NA	2,800	99	0	NA	18

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Median, not average.

[d] Average of medians reported for various industry segments.

[e] Analytical method did not distinguish between anthracene/phenanthrene.

INDUSTRIAL OCCURRENCE OF PHENANTHRENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Timber products processing	BDL	36,000	33[d]	0	1.5	0.0028
Petroleum refining	BDL	<10	<0.8[d]	0	0.074	0.0046
Auto and other laundries	ND	ND	ND	-[f]	-[f]	-[f]
Pharmaceutical manufacturing	ND	ND	ND	-[f]	-[f]	-[f]
Foundries	<4	3,200	480	0	3.2	1.3
Iron and steel manufacturing	NA	2,300	67	0	NA	12
Nonferrous metals manufacturing	ND	140	4.6	0	NA	0.24
Leather tanning and finishing[e]	ND	<10	4.1	0	NA	0.0062

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Analytical method did not distinguish between anthracene and phenanthrene.

[f] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIE FOR PHENANTHRENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	-Average achievable conc., µg/L	
Gravity oil separation			NA	3	III.4.1
Gas flotation			45	~600	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			83	66	III.4.5
Gas flotation with chemical addition (polymer)			0	-	III.4.5
Gas flotation with chemical addition (alum, polymer)			0	-	III.4.5
Filtration			40-70	400	III.4.6
Sedimentation			55-92	<14	III.4.2
Sedimentation with chemical addition (lime, polymer)			0	-	III.4.3
Sedimentation with chemical addition (polymer)			0	-	III.4.3
Sedimentation with chemical addition (alum)			0	-	III.4.3
Aerated lagoons			0[d,e]	-[e]	III.5.3
Ozonation			48->97[f]	0.2[f]	III.6.14
Activated sludge	~100	<50	57->97[f]	<2.5[f]	III.5.1
Granular activated carbon adsorption			>63->97[f]	0.12[f]	III.6.1
Powdered activated carbon adsorption	99	2.2			III.6.2
Reverse osmosis			77	0.7	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

[f] Analytical method did not distinguish between anthracene and phenanthrene.

REFERENCES

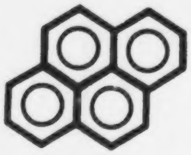
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 96-1 - 96-20.

2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-425.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Pyrene

Formula:



Alternate Names: Benzo(d,e,f)phenanthrene

CAS #: 129-00-0

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 202 m.p., °C: 150 b.p. (760 torr), °C: 393
vapor pressure (20°C), torr: 6.85×10^{-7}
solubility in water (25°C), mg/L: 0.14
log octanol/water partition coefficient: 5.32
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Low solubility probably hinders photolysis; relatively unimportant fate
oxidation: Chlorine and/or ozone in sufficient quantities can oxidize dissolved pyrene
hydrolysis: Not important
volatilization: Probably not as important as adsorption as a transport process; rate uncertain
sorption: Adsorption onto suspended particles, biota, and sediment is probably the dominant transport process
biological processes: Short-term bioaccumulation; metabolization and microbial degradation are the principal fates
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF PYRENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	19	4	0	0.11	0.015
Textile mills	NA	0.9[d]	0.9[d]	3.8×10^{-6}	0.026	0.0016
Timber products processing	BDL	22,000	1,000[e]	0	46	0.086
Petroleum refining[f]	∿30	∿40	∿35	0	∿3.2	∿0.20
Petroleum refining[f]	NA	16	16	0	1.5	0.093
Auto and other laundries	ND	11	6	5.4×10^{-6}	0.0084	0.0013
Leather tanning and finishing	ND	NA	0.14	0	NA	0.00021
Foundries	ND	1,100	44	0	0.30	0.12
Coil coating	ND	50	13	0.00065	0.023	0.0062
Nonferrous metals manufacturing	ND	7,000	130	0	NA	6.9
Iron and steel manufacturing	NA	26,000	79	0	NA	14

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Median, not average.

[f] Analytical method did not distinguish between pyrene and fluoranthene.

INDUSTRIAL OCCURRENCE OF PYRENE[a]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.2	0	0.0053	0.00076
Textile mills	NA	0.3	0.2[d]	8.4×10^{-7}	0.0058	0.00036
Timber products processing	BDL	9,400	77[d]	0	3.5	0.0066
Petroleum refining	BDL	7	7[d]	0	0.65	0.041
Auto and other laundries	ND	0.3	0.15	1.0×10^{-7}	0.00021	3.2×10^{-5}
Foundries	12	3,200	290	0	1.9	0.78
Iron and steel manufacturing	NA	1,100	43	0	NA	7.70
Nonferrous metals manufacturing	ND	180	11	0	NA	0.58

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR PYRENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gravity oil separation			NA	37	III.4.1
Gas flotation with chemical addition (polymer)			$0^{d,e}$	$-^{e}$	III.4.5
Filtration			0^{e}	$-^{e}$	III.4.6
Sedimentation			54-79	<18	III.4.2
Sedimentation with chemical addition (lime, polymer)			70->87	<10	III.4.3
Sedimentation with chemical addition (lime)			$0^{d,e}$	$-^{e}$	III.4.3
Aerated lagoons			67^{d}	1^{d}	III.5.3
Activated sludge	~100	<50	16-78	2	III.5.1
Granular activated carbon adsorption			>83->97	<0.01	III.6.1
Reverse osmosis			$0^{d,e}$	$-^{e}$	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 97-1 - 97-23.

2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-471.

Compound: Aroclor 1016

Formula: A mixture of mono, di, and trichloro isomers of the polychlorinated biphenyls (PCB's)

Alternate Names: None

CAS #: Not assigned

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 257.9* m.p., °C: Not available b.p. (760 torr), °C: 325-356
vapor pressure (25°C), torr: 4×10^{-4} (estimated)
solubility in water (temp. unknown), mg/L: 0.42
log octanol/water partition coefficient: 4.38
Henry's law constant: Not available
biodegradability: Aerobic degradation in semicontinuous activated sludge process; 30% degradation of <1 mg/L concentration after 48 hours incubation

---

*Average.

Probable Fate [1]

photolysis: Too slow to be important
oxidation: Not important
hydrolysis: Not important
volatilization: Slow volatilization is the cause of global distribution of PCB's, but is inhibited by adsorption
sorption: PCB's are rapidly adsorbed onto solids especially organic matter, and are often immobilized in sediments, but may reenter solution
biological processes: Strong bioaccumulation; mono-, di- and tri-chlorinated biphenyls are gradually biodegraded
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF AROCLOR 1016[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Petroleum refining	1.8	1.9	1.9[d]	0	0.18	0.011
Foundries[e]	ND	830	57	0	0.38	0.15
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Analytical method did not distinguish between Aroclor 1016, 1232, 1248, and 1260.

INDUSTRIAL OCCURRENCE OF AROCLOR 1016[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Petroleum refining	NA	NA	NA	NA	NA	NA
Foundries[d]	<5	480	64	0	0.43	0.17
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between Aroclor 1016, 1232, 1248, and 1260.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR AROCLOR 1016[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	1.3	III.4.1
Gas flotation			0[d,e]	-[e]	III.4.4
Activated sludge	47	2,650			III.5.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 36-1 - 36-18.

2. Tucker, E. S., V. W. Saeger, and O. Hicks. Activated Sludge Primary Biodegradation of Polychlorinated Biphenyls. Monsanto Company, St. Louis, Missouri, March 1975. 9 pp.

Compound: Aroclor 1221

Alternate Names: None

Formula: A mixture of polychlorinated biphenyls which is approximately 21% chlorine by weight

CAS #: 111-042-82

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 200.7* m.p., °C: Not available b.p. (760 torr), °C: 275-320
vapor pressure (25°C), torr: 6.7×10^{-3} (estimated)
solubility in water (25°C), mg/L: 15 (estimated)
log octanol/water partition coefficient: 2.8 (estimated)
Henry's law constant: Not available
biodegradability: Aerobic degradation in semicontinuous activated sludge process; 80% degradation of <5 mg/L concentration after 48 hour incubation

---

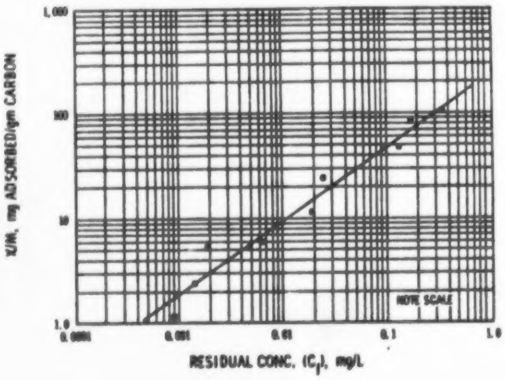
*Average.

Probable Fate [1]

photolysis: Too slow to be important
oxidation: Not important
hydrolysis: Not important
volatilization: Slow volatilization distributes PCB's globally, but is inhibited by adsorption
sorption: PCB's are rapidly adsorbed onto solids, especially organic matter, and are often immobilized in sediment, but may reenter solution
biological processes: Strong bioaccumulation; mono-, di-, and tri-chlorinated biphenyls are gradually biodegraded
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 37 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF AROCLOR 1221[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Petroleum refining	0.1	<5	<3[d]	0	0.28	0.017
Foundries[e]	ND	1,400	79	0	0.53	0.21
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Analytical method did not distinguish between Aroclor 1221 and Aroclor 1254.

INDUSTRIAL OCCURRENCE OF AROCLOR 1221[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Petroleum refining	NA	<5[d]	<5[d]	0	0.46	0.029
Foundries[e]	<5	650	78	0	0.52	0.21
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Analytical method did not distinguish between Aroclor 1221 and Aroclor 1254.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR AROCLOR 1221[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gravity oil separation			NA	0.1[d]	III.4.1
Activated sludge	~100	<50			III.5.1
Powdered activated carbon adsorption	~100	1			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 36-1 - 36-18.

2. Tucker, E. S., V. W. Saeger, and O. Hicks. Activated Sludge Primary Biodegradation of Polychlorinated Biphenyls. Monsanto Company, St. Louis, Missouri, March 1975. 9 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Aroclor 1232

Alternate Names: None

CAS #: 111-411-65

Formula: A mixture of polychlorinated biphenyls which is approximately 32% chlorine by weight

Physical, Chemical, and Biological Properties [1]

mol. wt.: 232.2* m.p., °C: Not available b.p. (760 torr), °C: 290-325
vapor pressure (25°C), torr: 4.06×10^{-3} (estimated)
solubility in water (25°C), mg/L: 1.45 (estimated)
log octanol/water partition coefficient: 3.2 (estimated)
Henry's law constant: Not available
biodegradability: Not available

---

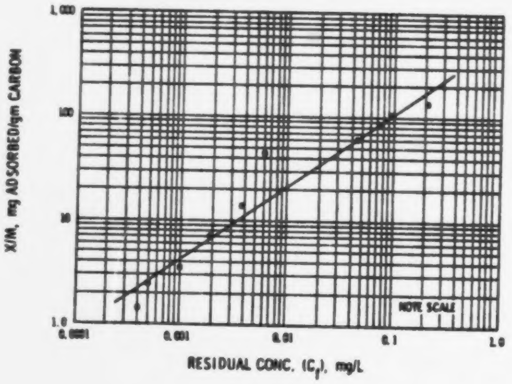
*Average.

Probable Fate [1]

photolysis: Too slow to be important
oxidation: Not important
hydrolysis: Not important
volatilization: Slow volatilization distributes PCB's globally, but is inhibited by adsorption
sorption: PCB's are rapidly adsorbed onto solids, especially organic matter, and are often immobilized in sediment, but may reenter solution
biological processes: Strong bioaccumulation, mono-, di-, and tri-chlorinated biphenyls are gradually biodegraded
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 14 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF AROCLOR 1232[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Petroleum	0.5	0.9	0.7[d]	0	0.065	0.0041
Pulp, paper and paperboard mills	NA	<1[e]	<1[e]	0	NA	0.030
Foundries[f]	ND	830	57	0	0.38	0.15
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] One sample.

INDUSTRIAL OCCURRENCE OF AROCLOR 1232[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Petroleum refining	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	NA	NA	NA	NA	NA	NA
Foundries[d]	<5	480	64	0	0.43	0.17
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between Aroclor 1016, 1232, 1248, and 1260.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR AROCLOR 1232[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	0.63	III.4.1
Filtration			16[d]	480[d]	III.4.6
Activated sludge	~100	<50			III.5.1
Powdered activated carbon adsorption	100	0.1			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 36-1 - 36-18.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Aroclor 1242

Formula: A mixture of polychlorinated biphenyls which is approximately 42% chlorine by weight

Alternate Names: None

CAS #: 534-692-19

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 266.5* m.p., °C: Not available b.p. (760 torr), °C: 325-366
vapor pressure (25°C), torr: 4.06×10^{-4}
solubility in water (25°C), mg/L: 0.24
log octanol/water partition coefficient: 4.11
Henry's law constant: 5.7×10^{-4} atmos. m^3 $mole^{-1}$
biodegradability: Aerobic degradation in semicontinuous activated sludge process; 26% degradation of <1 mg/L concentration after 48 hour incubation

---

*Average.

Probable Fate [1]

photolysis: Inhibited by presence of oxygen, but possibly the only degradative pathway for highly-chlorinated PCB's
oxidation: Not important
hydrolysis: Not important
volatilization: Slow volatilization causes global dispersion of PCB's, but is inhibited by adsorption
sorption: PCB's are rapidly adsorbed onto solids, especially organic matter, and are often immobilized in sediment, but may reenter solution
biological processes: Strong bioaccumulation; mono-, di-, and tri-chlorinated biphenyls are gradually biodegraded
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

Date: 6/23/80

INDUSTRIAL OCCURRENCE OF AROCLOR 1242^{a,b}

Industry	Raw wastewater					
	Concentration, μg/L			Loading,^{c} kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Petroleum refining	NA	0.5^{d}	0.5^{d}	0	0.046	0.0029
Pulp, paper and paperboard mills	NA	2^{d}	2^{d}	0	NA	0.060
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF AROCLOR 1242[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Petroleum refining	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	NA	NA	NA	NA	NA	NA
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR AROCLOR 1242[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	3.6	III.4.1
Gas flotation			0[d,e]	-[e]	III.4.4
Filtration			16[d]	480[d]	III.4.6
Activated sludge	66	1,700			III.5.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 36-1 - 36-18.

2. Tucker, E. S., V. W. Saeger, and O. Hicks. Activated Sludge Primary Biodegradation of Polychlorinated Biphenyls. Monsanto Company, St. Louis, Missouri, March 1975. 9 pp.

Compound: Aroclor 1248

Formula: A mixture of polychlorinated biphenyls which is approximately 48% chlorine by weight

Alternate Names: None

CAS #: 126-722-96

Physical, Chemical, and Biological Properties [1]

mol. wt.: 299.5* m.p., °C: Not available b.p. (760 torr), °C: 340-375
vapor pressure (25°C), torr: 4.94×10^{-4}
solubility in water (25°C), mg/L: 0.054
log octanol/water partition coefficient: 5.75 (estimated)
Henry's law constant: 3.5×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

---

*Average.

Probable Fate [1]

photolysis: Inhibited by presence of oxygen, but possibly the only degradative pathway for highly-chlorinated PCB's
oxidation: Not important
hydrolysis: Not important
volatilization: Slow volatilization causes global dispersion of PCB's but is inhibited by adsorption
sorption: PCB's are rapidly adsorbed onto solids, especially organic matter and are often immobilized in sediment, but may reenter solution
biological processes: Strong bioaccumulation
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF AROCLOR 1248[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pulp, paper and paperboard mills	NA	18[d]	18[d]	0	NA	0.54
Foundries[e]	ND	830	57	0	0.381	0.15
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	32	0.7	0	NA	0.037

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Analytical method did not distinguish between Aroclor 1016, 1232, 1248, and 1260.

INDUSTRIAL OCCURRENCE OF AROCLOR 1248[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pulp, paper and paperboard mills	0	<1[d]	<1[d]	0	NA	0.030
Foundries[e]	<5	480	64	0	0.43	0.17
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	9.8	1.1	0	NA	0.06

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Analytical method did not distinguish between Aroclor 1016, 1232, 1248, and 1260.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR AROCLOR 1248[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Filtration			16[d]	480[d]	III.4.6
Activated sludge	0	NA			III.5.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 36-1 - 36-18.

Compound: Aroclor 1254

Formula: A mixture of polychlorinated biphenyls which is approximately 54% chlorine by weight

Alternate Names: None

CAS #: 110-976-91

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 328.4* m.p., °C: Not available b.p. (760 torr), °C: 365-390
vapor pressure (25°C), torr: 7.71×10^{-5}
solubility in water (25°C), mg/L: 0.012
log octanol/water partition coefficient: 6.03 (estimated)
Henry's law constant: 8.37×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Aerobic degradation in semicontinuous activated sludge process; 15% degradation of <1 mg/L concentrations after 48 hour incubation

---

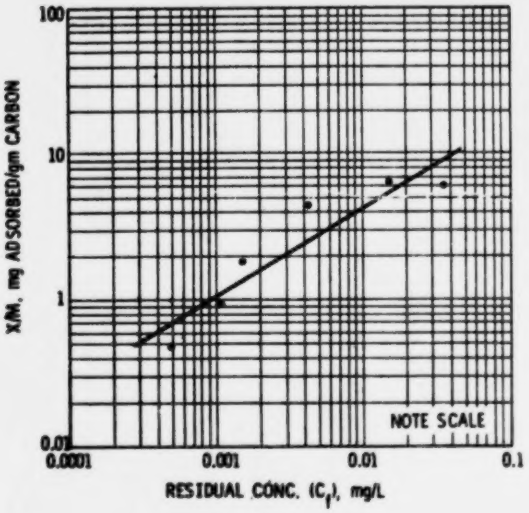
*Average.

Probable Fate [1]

photolysis: Supressed by presence of oxygen, but possibly the only degradative mechanism for highly-chlorinated PCB's
oxidation: Not important
hydrolysis: Not important
volatilization: Slow volatilization distributes PCB's globally, but is inhibited by adsorption
sorption: PCB's are rapidly adsorbed onto solids, especially organic matter, and are often immobilized in sediment, but may reenter solution
biological processes: Strong bioaccumulation
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: Not available
type of carbon: Filtrasorb-300
adsorbability: Not available



INDUSTRIAL OCCURRENCE OF AROCLOR 1254[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pulp, paper and paperboard mills	NA	<1[d]	1	0	NA	0.030
Foundries[e]	ND	1,400	79	0	0.53	0.21
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	52	1.1	0	NA	0.058

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Analytical method did not distinguish between Aroclor 1221 and Aroclor 1254.

INDUSTRIAL OCCURRENCE OF AROCLOR 1254[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pulp, paper and paperboard mills	<1	2	<1	0	NA	0.030
Foundries[d]	<5	650	78	0	0.52	0.21
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	7.0	0.8	0	NA	0.042

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between Aroclor 1221 and Aroclor 1254.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR AROCLOR 1254[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Filtration			20[d]	650[d]	III.4.6
Activated sludge	42	2,900			III.5.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 36-1 - 36-18.

2. Tucker, E. S., V. W. Saeger, and O. Hicks. Activated Sludge Primary Biodegradation of Polychlorinated Biphenyls. Monsanto Company, St. Louis, Missouri, March 1975. 9 pp.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

Compound: Aroclor 1260

Formula: A mixture of polychlorinated biphenyls which is approximately 60% chlorine by weight

Alternate Names: None

CAS #: 110-968-25

Physical, Chemical, and Biological Properties [1]

mol. wt.: 375.7* m.p., °C: Not available b.p. (760 torr), °C: 385-420
vapor pressure (25°C), torr: 4.05×10^{-5}
solubility in water (25°C), mg/L: 0.0027
log octanol/water partition coefficient: 7.14 (estimated)
Henry's law constant: 7.1×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

---

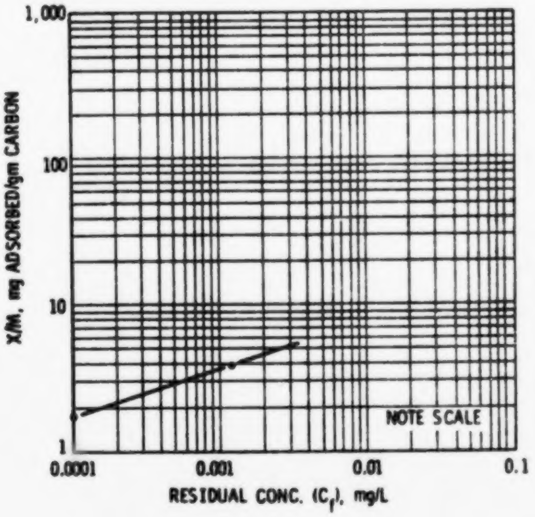
*Average.

Probable Fate [1]

photolysis: Inhibited by presence of oxygen, but possibly the only degradative mechanism for highly-chlorinated PCB's
oxidation: Not important
hydrolysis: Not important
volatilization: Slow volatilization distributes PCB's globally, but is inhibited by adsorption
sorption: PCB's are rapidly adsorbed onto solids, especially organic matter and are often immobilized in sediment, but may reenter solution
biological processes: Strong bioaccumulation
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: Not available
type of carbon: Filtrasorb-300
adsorbability: Not available



INDUSTRIAL OCCURRENCE OF AROCLOR 1260[a,b]

	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries[d]	ND	830	57	0	0.38	0.15
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between Aroclor 1016, 1232, 1248, and 1260.

INDUSTRIAL OCCURRENCE OF AROCLOR 1260[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries[d]	<5	480	64	0	0.43	0.17
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Analytical method did not distinguish between Aroclor 1016, 1232, 1248, and 1260.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR AROCLOR 1260[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., μg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., μg/L	Volume III references, Section numbers
Filtration			16[d]	480[d]	III.4.6
Activated sludge	21	3,950			III.5.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

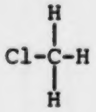
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 36-1 - 36-18.

2. Report on visit of D. Stephan and W. Cawley, U.S. Environmental Protection Agency, to Calgon Environmental Systems Division, Calgon Corporation, Pittsburgh, Pennsylvania, 9 April 1979. 132 pp.

Compound: Methyl chloride

Formula:



$$\mathrm{Cl{-}\overset{\displaystyle H}{\underset{\displaystyle H}{C}}{-}H}$$

Alternate Names: Chloromethane,
Monochloromethane

CAS #: 74-87-3

Physical, Chemical, and Biological Properties [1]

mol. wt.: 50.59 m.p., °C: -97.7 b.p. (760 torr), °C: -24.2
vapor pressure (20°C), torr: 3,765
solubility in water (20°C), mg/L: 6,450-7,250
log octanol/water partition coefficient: 0.91
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Information lacking, probably unimportant; appreciable photodissociation may occur in stratosphere
oxidation: Information lacking, probably unimportant; in troposphere oxidation by hydroxyl radicals for formyl chloride and other products important fate
hydrolysis: Slow hydrolysis, unimportant in comparison to volatilization
volatilization: Volatilization to the atmosphere is rapid and is a major transport process for removal of methyl chloride
sorption: No data available, sorption onto sediments and suspended particulates probably unimportant
biological processes: Data lacking, biodegradation and bioaccumulation are not expected to be important fates
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF METHYL CHLORIDE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	<5[d]	<5[d]	2.1×10^{-5}	0.14	0.0090
Timber products processing	BDL	2,600	77[e]	0	3.5	0.0066
Pharmaceutical manufacturing	ND	1,500	300	0	2	0.28
Ore mining and dressing	ND	ND	ND	-[d]	-[d]	-[d]

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Median, not average.

INDUSTRIAL OCCURRENCE OF METHYL CHLORIDE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Timber products processing	13	1,900	140[d]	0	6.4	0.012
Textile mills	NA	NA	NA	NA	NA	NA
Pharmaceutical manufacturing	ND	ND	ND	-[e]	-[e]	-[e]

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR METHYL CHLORIDE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gas flotation with chemical addition (polymer)			$0^{d,e}$	$-^{e}$	III.4.5
Filtration			$>87^{d}$	$<0.4^{d}$	III.4.6
Sedimentation			59->99	64	III.4.2
Aerated lagoons			$>91^{d}$	$<5^{d}$	III.5.3
Reverse osmosis			$0^{d,e}$	$-^{e}$	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

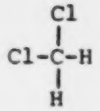
[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 38-1 - 38-9.

Compound: Methylene chloride

Formula:



$$\begin{array}{c} Cl \\ | \\ Cl-C-H \\ | \\ H \end{array}$$

Alternate Names: Dichloromethane, Methylene dichloride, Methane dichloride, Methylene bichloride

CAS #: 74-09-2

Physical, Chemical, and Biological Properties [1, 2]

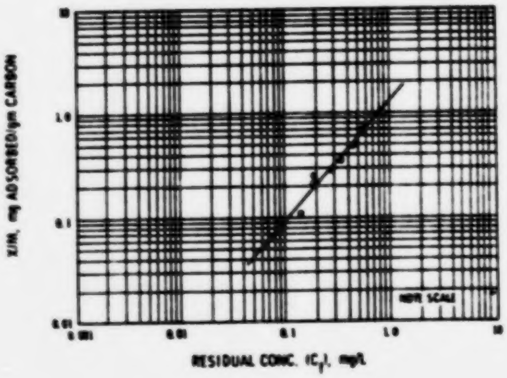
mol. wt.: 84.94 m.p., °C: -95 b.p. (760 torr), °C: 39.8
vapor pressure (20°C), torr: 362
solubility in water (25°C), mg/L: 16,700
log octanol/water partition coefficient: 1.25
Henry's law constant: 3.19×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Photochemical reactions in aqueous media are probably unimportant slow photodecomposition in troposphere in the presence of nitrogen oxides is possible, appreciable photodissociation may occur in stratosphere
oxidation: Information lacking, probably unimportant; in troposphere oxidation by hydroxyl radicals to carbon dioxide, carbon monoxide, and phosgene is important fate mechanism
hydrolysis: Not important fate process
volatilization: Due to high vapor pressure, volatilization to the atmosphere is rapid and is a major transport process
sorption: Data lacking, sorption by inorganic and organic materials not expected to be important fate mechanism
biological processes: Data lacking, bioaccumulation not expected, biodegradation may be possible
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 5.8
type of carbon: Filtrasorb-300
adsorbability: 7,000 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.8



INDUSTRIAL OCCURRENCE OF METHYLENE CHLORIDE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	82	14	0	0.37	0.053
Textile mills	NA	110	47	0.00020	1.3	0.085
Timber products processing	BDL	20	NA	0	0.46	0.00086
Petroleum refining	>30	>90	>45[d]	0	4.2	0.26
Paint and ink formulation	ND	210,000	17,000	0	0.78	0.027
Gum and wood chemicals	190	16,000	4,000	0.036	30	6.6
Rubber processing	NA	70	19	3.8×10^{-6}	0.016	0.00063
Pulp, paper and paperboard mills	<1	4	<1.9	0	NA	0.057
Auto and other laundries	ND	640	64	5.8×10^{-5}	0.09	0.013
Pharmaceutical manufacturing	ND	20,000	2,600	0	17.7	2.4
Ore mining and dressing	2.5	8	5.3	0	NA	0.2
Steam electric power generating (condenser cooling system)	65	9,400	2,300	0.12	2.5	0.55
Steam electric power generating (water treatment)	NA	NA	1.2[e]	7.3×10^{-9}	0.072	180
Steam electric power generating (ash handling)	>140	>9,400	3,300	0.063	320	73
Inorganic chemicals manufacturing	NA	NA	NA	NA	NA	NA
Coil coating	<10	<10	<10	<0.0005	<0.018	<0.0048
Foundries	ND	2,400	100	0	0.67	0.27
Nonferrous metals manufacturing	ND	88,000	680	0	NA	36
Iron and steel manufacturing	NA	140	50	0	NA	9

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] One sample.

INDUSTRIAL OCCURRENCE OF METHYLENE CHLORIDE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	21	6	0	0.16	0.023
Textile mills	NA	<5	<5	2.1×10^{-5}	0.14	0.0090
Timber products processing	BDL	23	BDL	–[d]	–[d]	–[d]
Petroleum refining	50	>60	>50[e]	0	4.6	0.29
Paint and ink formulation	ND	3,100	5,600	0	0.26	0.0090
Gum and wood chemicals	85	2,400	1,000	0.0090	7.6	1.6
Rubber processing	NA	520	170	3.4×10^{-5}	0.15	0.0056
Pulp, paper and paperboard mills	<1	270	<19	0	NA	0.57
Auto and other laundries	ND	1,200	440	0.00040	0.616	0.092
Pharmaceutical manufacturing	ND	850,000	75,000	0	510	69
Foundries	<5	2,500	270	0	1.8	0.73
Nonferrous metals manufacturing	ND	4,300	140	0	NA	7.4
Iron and steel manufacturing	NA	270	37	0	NA	6.7

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] Median, not average.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR METHYLENE CHLORIDE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	>42	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			2-7	2,200	III.4.5
Gas flotation with chemical addition (polymer)			61[d]	22[d]	III.4.5
Gas flotation with chemical addition (alum, polymer)			84[d]	8[d]	III.4.5
Filtration			14-62	2,400	III.4.6
Sedimentation			38-88	530	III.4.2
Sedimentation with chemical addition (alum, lime)			13[d]	2,000[d]	III.4.3
Sedimentation with chemical addition (lime, polymer)			0[e]	-[e]	III.4.3
Sedimentation with chemical addition (polymer)			0[e]	-[e]	III.4.3
Sedimentation with chemical addition (alum, polymer)			56-98	5,600	III.4.3
Sedimentation with chemical addition (alum)			>78->99	<40	III.4.3
Aerated lagoons			65-97	390	III.5.3
Steam stripping			75-87	160,000	III.5.5
Trickling filters			0[d,e]	-[e]	III.5.2
Ozonation			0[e]	-[e]	III.6.14
Activated sludge	~100	<50	21-99	95	III.5.1
Granular activated carbon adsorption			31-92	140	III.6.1
Powdered activated carbon adsorption	84	162			III.6.2
Reverse osmosis			21-64	5	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

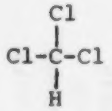
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 39-1 - 39-11.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Chloroform

Formula:



$$\mathrm{Cl{-}\overset{\overset{\Large Cl}{|}}{\underset{\underset{\Large H}{|}}{C}}{-}Cl}$$

Alternate Names: Trichloromethane

CAS #: 67-66-3

Physical, Chemical, and Biological Properties [1, 2]

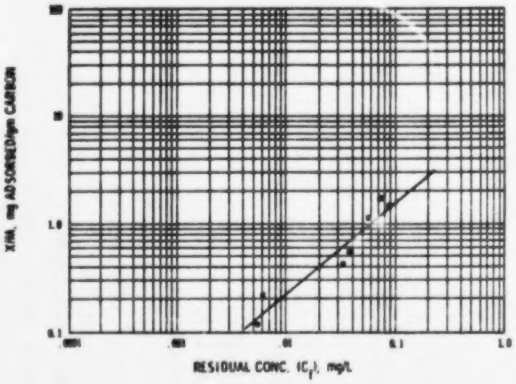
mol. wt.: 119.4   m.p., °C: -63.5   b.p. (760 torr), °C: 61.7
vapor pressure (20°C), torr: 150
solubility in water (20°C), mg/L: 9,600
log octanol/water partition coefficient: 1.97
Henry's law constant: 3.39×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1, 3]

photolysis: Could be important, photodissociation can occur in stratosphere
oxidation: Could be important in sunlight; in troposphere oxidation by hydroxyl radicals to phosgene and chlorine oxide is important fate mechanism
hydrolysis: Not important fate process
volatilization: Volatilization is a major transport process for removal of chloroform from aqueous mediums
sorption: Data lacking, sorption by inorganic and organic materials not expected to be important fate mechanism
biological processes: Data lacking; some bioaccumulation is indicated, biodegradation may be possible
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 7.3
type of carbon: Filtrasorb-300
adsorbability: 820 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF CHLOROFORM[a,b]

Industry	Raw wastewater: Concentration, μg/L: Minimum	Maximum	Mean	Loading,[c] kg/d: Minimum	Maximum	Mean
Coal mining	ND	<6.7	<1		0.026	0.0038
Textile mills	NA	640	48[d]	0.00020	1.4	0.086
Timber products processing	BDL	20	NA	0	0.46	0.00086
Paint and ink formulation	ND	900	120	0	0.0055	0.00019
Gum and wood chemicals	<10	1,400	<680	0.0061	5.1	1.1
Rubber processing	NA	270	27	5.4×10^{-6}	0.023	0.00089
Petroleum refining	10	15	13[d]	0	1.2	0.11
Pulp, paper and paperboard mills	<1	17	<6	0	NA	0.18
Auto and other laundries	ND	35,000	780	0.0007	1.1	0.16
Pharmaceutical manufacturing	ND	1,600	300	0	2	0.28
Ore mining and dressing	1.1	4.6	2.9	0	NA	0.11
Steam electric power generating (water treatment)	NA	NA	14[e]	6.1×10^{-9}	0.84	0.0021
Inorganic chemicals manufacturing	NA	690[f]	NA	0	43	8.6
Leather tanning and finishing	ND	41	15	0	NA	0.023
Iron and steel manufacturing	NA	1,400	64	0	NA	3.4
Nonferrous metals manufacturing	ND	1,800	61	0	NA	11

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] Average of medians reported for various industry segments.

[f] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF CHLOROFORM[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<2.4	0	0.064	0.0091
Textile mills	NA	58	8.5	0.000036	0.24	0.015
Petroleum refining	NA	NA	NA	NA	NA	NA
Paint and ink formulation	ND	4,700	390	0	0.018	0.00062
Gum and wood chemicals	10	1,400	670	0.0060	5.1	1.1
Timber products processing	NA	NA	NA	NA	NA	NA
Rubber processing	NA	100	4.7	9.4×10^{-7}	0.0040	0.00015
Pulp, paper and paperboard mills	<1	430	<46	0	NA	1.4
Auto and other laundries	8	44	18	7.2×10^{-6}	0.025	0.0038
Pharmaceutical manufacturing	ND	1,400	150	0	1.0	0.14
Foundries	7	500	85	0	0.57	0.23
Iron and steel manufacturing	NA	280	31	0	NA	5.6
Nonferrous metals manufacturing	ND	2,900	98	0	NA	5.2
Leather tanning and finishing	ND	10	5	0	NA	0.0075

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CHLOROFORM[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	58	III.4.1
Gas flotation			$0^{d,e}$	$-^{e}$	III.4.4
Gas flotation with chemical addition (calcium chloride, polymer)			31-74	5.9	III.4.5
Gas flotation with chemical addition (polymer)			41^{d}	24^{d}	III.4.5
Gas flotation with chemical addition (alum, polymer)			$0^{d,e}$	$-^{e}$	III.4.5
Filtration			0^{e}	$-^{e}$	III.4.6
Sedimentation			16->81	110	III.4.2
Sedimentation with chemical addition (alum, lime)			$0^{d,e}$	$-^{e}$	III.4.3
Sedimentation with chemical addition (lime, polymer)			26->78	<9	III.4.3
Sedimentation with chemical addition (polymer)			$0^{d,e}$	$-^{e}$	III.4.3
Sedimentation with chemical addition (alum, polymer)			27->94	140	III.4.3
Sedimentation with chemical addition (alum)			$0^{d,e}$	$-^{e}$	III.4.3
Aerated lagoons			36->57	340	III.5.3
Steam stripping			89->99	13,000	III.5.5
Trickling filters			$0^{d,e}$	$-^{e}$	III.5.2
Activated sludge	~100	<50	63->99	<13	III.5.1
Granular activated carbon adsorption			>67->99	<11	III.6.1
Powdered activated carbon adsorption	97	30			III.6.2
Reverse osmosis			20-79	16	III.6.9

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 40-1 - 40-12.

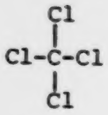
2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Interscience Encyclopedia, Inc. Encyclopedia of Chemical Technology, Volume 5, 3rd Edition. New York, New York, 1978.

4. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Carbon tetrachloride

Formula:



$\mathrm{Cl-\overset{\displaystyle Cl}{\underset{\displaystyle Cl}{C}}-Cl}$

Alternate Names: Tetrachloromethane, Methane tetrachloride, Perchloromethane, Benzinoform

CAS #: 56-23-5

Physical, Chemical, and Biological Properties [1, 2]

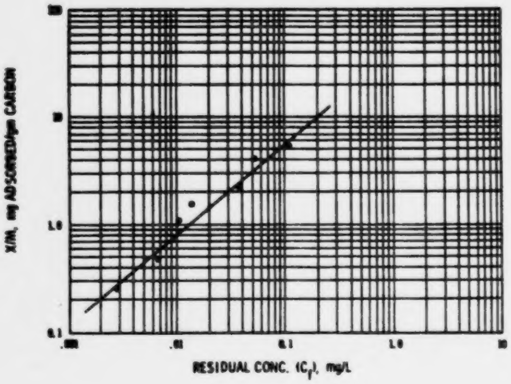
mol. wt.: 153.8 m.p., °C: -22.9 b.p. (760 torr), °C: 76.5
vapor pressure (20°C), torr: 90
solubility in water (20°C), mg/L: 800
log octanol/water partition coefficient: 2.64
Henry's law constant: 30.2×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Could be important in aqueous environment; in the stratsophere photodissociation occurs to eventually form phosgene as the principal product
oxidation: No information available; in troposphere it exhibits an extremely slow rate of reaction with hydroxyl radicals
hydrolysis: Data unavailable
volatilization: Volatilization is rapid and is an important transport process for the removal of tetrachloromethane from aquatic systems
sorption: Little data available, but adsorption onto sediments rich in organic material possible
biological processes: Little data available, some bioaccumulation and biodegradation possible
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: 7.3
type of carbon: Filtrasorb-300
adsorbability: 225 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF CARBON TETRACHLORIDE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1.4	0	0.037	0.0053
Paint and ink formulation	ND	30,000	1,900	0	0.087	0.0030
Rubber processing	NA	350	180	3.6×10^{-5}	0.15	0.0059
Auto and other laundries	ND	1,700	95	8.6×10^{-5}	0.13	0.02
Pharmaceutical manufacturing	ND	6,000	460	0	3.1	0.42
Ore mining and dressing	ND	ND	ND	-[e]	-[e]	-[e]
Inorganic chemicals manufacturing	NA	200[d]	NA	0	13	2.5
Foundries	ND	480	45	0	0.3	0.12
Iron and steel manufacturing	NA	NA	40	0	NA	7.2
Nonferrous metals manufacturing	ND	2,300	81	0	NA	4.3

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Average of maximums reported for various industry segments.

[e] Mean pollutant concentration below detection limit.

INDUSTRIAL OCCURRENCE OF CARBON TETRACHLORIDE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<0.5	0	0.013	0.0019
Paint and ink formulation	ND	1,800	640	0	0.029	0.0010
Rubber processing	NA	1,400	700	0.00014	0.60	0.023
Pharmaceutical manufacturing	ND	300	21	0	0.14	0.02
Foundries	<10	39	22	0	0.15	0.059
Iron and steel manufacturing	NA	NA	8	0	NA	1.4
Nonferrous metals manufacturing	ND	1,700	88	0	NA	0.13

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CARBON TETRACHLORIDE[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	1^{d}	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			50^{d}	1^{d}	III.4.5
Gas flotation with chemical addition (alum, polymer)			76^{d}	410^{d}	III.4.5
Filtration			>73-93	<32	III.4.6
Sedimentation with chemical addition (alum, lime)			$>17^{d}$	$<10^{d}$	III.4.3
Sedimentation with chemical addition (alum, polymer)			94^{d}	$1,800^{d}$	III.4.3
Activated sludge	~100	<50	$0^{d,e}$	$-^{e}$	III.5.1
Powdered activated carbon adsorption	98	17			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

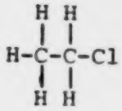
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 41-1 - 41-10.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Chloroethane

Formula:



$\mathrm{CH_3CH_2Cl}$

Alternate Names: Ethyl chloride, monochloroethane, Hydrochloric ether, Muriatic ether

CAS #: 75-00-3

Physical, Chemical, and Biological Properties [1]

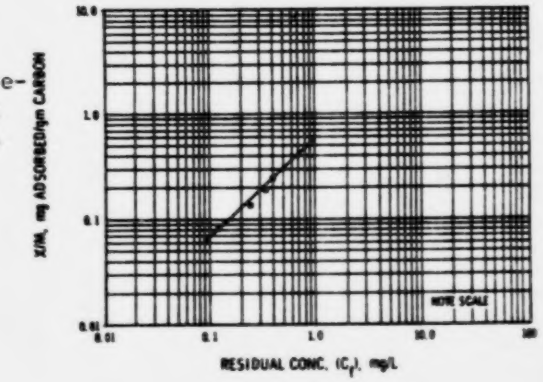
mol. wt.: 64.52 m.p., °C: -136 b.p. (760 torr), °C: 12.3
vapor pressure (20°C), torr: 1,000
solubility in water (20°C), mg/L: 5,740
log octanol/water partition coefficient: 1.54
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: No information available pertaining to rate of photodissociation in aqueous environment; photodissociation to formyl chloride may occur in stratosphere
oxidation: Photooxidation in troposphere is primary fate mechanism, photooxidation in the aquatic environment probably occurs at a slow rate
hydrolysis: Probably cannot compete with volatilization
volatilization: Probable primary transport mechanism
sorption: No data available
biological processes: No data available, biodegradation and bioaccumulation are not expected to be important fate
other reactions/interactions: Unknown

Carbon Adsorption Data [2]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 15,000 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF CHLOROETHANE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Gum and wood chemicals	BDL	520	170	0.0015	1.3	0.38
Rubber processing	NA	4,900[d]	4,900[d]	0.00098	4.2	0.16

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF CHLOROETHANE[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Gum and wood chemicals	NA	NA	NA	NA	NA	NA
Rubber processing	NA	NA	NA	NA	NA	NA

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CHLOROETHANE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., μg/L	Volume III references, Section numbers
Granular activated carbon adsorption			58->99	71,000	III.6.1
Powdered activated carbon adsorption	88	129			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

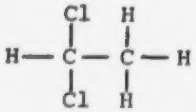
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 42-1 - 42-9.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 1,1-Dichloroethane

Formula:



$$H-\underset{Cl}{\overset{Cl}{C}}-\underset{H}{\overset{H}{C}}-H$$

Alternate Names: Ethylidene chloride,
Ethylidene dichloride

CAS #: 75-34-3

Physical, Chemical, and Biological Properties [1, 2]

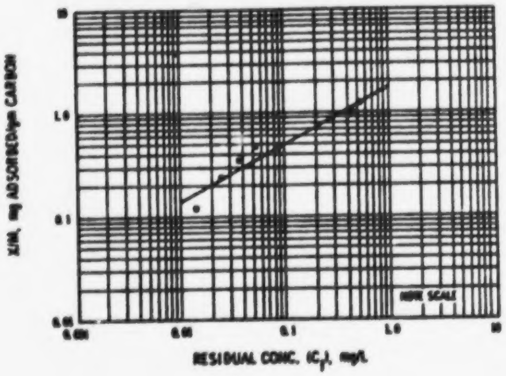
mol. wt.: 98.96 m.p., °C: -97.0 b.p. (760 torr), °C: 57.3
vapor pressure (25°C), torr: 180
solubility in water (20°C), mg/L: 5,500
log octanol/water partition coefficient: 1.79
Henry's law constant: 5.45×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Information lacking; photodissociation to chloroacetyl chloride in stratosphere is predicted
oxidation: Photooxidation in troposphere may be the predominant fate, photooxidation in aquatic environment probably occurs at a slow rate
hydrolysis: Probably cannot compete with volatilization
volatilization: Due to high vapor pressure, volatilization to the atmosphere should be major transport process
sorption: No data available
biological processes: Data lacking; bioaccumulation not expected, biodegradation may be possible
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 5,000 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF 1,1-DICHLOROETHANE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills[d]	NA	14	14	5.9×10^{-5}	0.40	0.025
Paint and ink formulation	ND	33	10	0	0.00046	1.6×10^{-5}
Rubber processing	NA	<2[d]	<2[d]	4.0×10^{-7}	0.0017	6.6×10^{-5}
Pharmaceutical manufacturing	ND	ND	ND	–[e]	–[e]	–[e]
Leather tanning and finishing	ND	NA	<3	0	NA	<0.0045
Foundries	55[d]	55[d]	55[d]	0	0.37	0.14
Coil coating	ND	18	18	0.0009	0.032	0.0086
Nonferrous metals manufacturing	ND	180	20	0	NA	1.1
Iron and steel manufacturing	NA	NA	8	0	NA	1.4

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Mean pollutant concentration below detection limit.

INDUSTRIAL OCCURRENCE OF 1,1-DICHLOROETHANE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Paint and ink formulation	ND	180	95	0	0.0044	0.00015
Textile mills	NA	NA	NA	NA	NA	NA
Rubber processing	NA	110	56	1.1×10^{-5}	0.048	0.0018
Pharmaceutical manufacturing	ND	28	7	0	0.048	0.0064
Iron and steel manufacturing	NA	NA	7	0	NA	1.3
Nonferrous metals manufacturing	ND	7	0.6	0	NA	0.032

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,1-DICHLOROETHANE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., μg/L	Volume III references, Section numbers
Gravity oil separation			NA	1[d]	III.4.1
Filtration			0[d,e]	-[e]	III.4.6
Sedimentation			>0[d]	<10[d]	III.4.2
Activated sludge	91	450	>9->18	<3.5	III.5.1
Granular activated carbon adsorption			>89->99	8,100	III.6.1
Powdered activated carbon adsorption	99	14			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

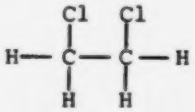
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 43-1 - 43-10.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 1,2-Dichloroethane

Formula:



$$\begin{array}{cccc} & \mathrm{Cl} & \mathrm{Cl} & \\ & | & | & \\ \mathrm{H}- & \mathrm{C}- & \mathrm{C} & -\mathrm{H} \\ & | & | & \\ & \mathrm{H} & \mathrm{H} & \end{array}$$

Alternate Names: Ethylene dichloride,
Glycol dichloride

CAS #: 107-06-2

Physical, Chemical, and Biological Properties [1, 2]

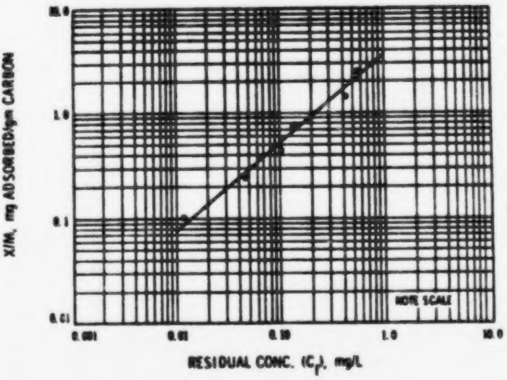
mol. wt.: 98.98 m.p., °C: -35.4 b.p. (760 torr), °C: 83.5
vapor pressure (20°C), torr: 61
solubility in water (20°C), mg/L: 8,300
log octanol/water partition coefficient: 1.48
Henry's law constant: 1.10×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Information not available; photodissociation in stratosphere to chloroacetyl chloride is expected
oxidation: Photooxidation in troposphere may be the predominant fate, photooxidation in the aquatic environment occurs at a slow rate
hydrolysis: Hydrolysis is probably too slow to be an important process for removal of 1,2-dichloroethane
volatilization: Due to high vapor pressure, volatilization to the atmosphere is rapid and is major transport process
sorption: Information not available
biological processes: Information not available
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 2,500 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF 1,2-DICHLOROETHANE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal minimg	NA	ND	ND	-[e]	-[e]	-[e]
Textile mills	NA	<5[d]	<5[d]	2.1 x 10^{-5}	0.14	0.0090
Paint and ink formulation	ND	420	100	0	0.0046	0.00016
Rubher processing	NA	93[d]	93[d]	0.000018	0.080	0.0031
Pulp, paper and paperboard mills	NA	NA	NA	NA	NA	NA
Auto and other laundries	ND	500	250	0.00023	0.35	0.052
Pharmaceutical manufacturing	ND	74	8.7	0	0.059	0.0074
Steam electric power generating (condenser cooling system)	NA	NA	44[f]	0.0023	0.048	0.011
Steam electric power generating (ash handling)	NA	NA	27[f]	0.00051	2.6	0.59
Inorganic chemical manufacturing	NA	620[g]	NA	0	39	7.8
Foundries	NA	170	83	0	0.56	0.24
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	180	20	0	NA	1.1

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Mean pollutant concentration below detection limit.

[f] Average of medians reported for various industry segments.

[g] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF 1,2-DICHLOROETHANE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.2	0	0.0053	0.0007
Paint and ink formulation	ND	170	70	0	0.0032	0.00011
Textile mills	NA	NA	NA	NA	NA	NA
Rubber processing	NA	4	3	6×10^{-7}	0.0026	9.9×10^{-5}
Pulp, paper and paperboard mills	NA	<1[d]	<1[d]	0	NA	0.030
Pharmaceutical manufacturing	ND	7,000	500	0	3.4	0.46
Foundries	<20	<20	<20	0	0.13	0.054
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	240	11	0	NA	0.58

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,2-DICHLOROETHANE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., μg/L	Volume III references, Section numbers
Filtration			0[d,e]	-[e]	III.4.6
Sedimentation			>70[d]	<10[d]	III.4.2
Sedimentation with chemical addition (alum, polymer)			30->60	<50	III.4.3
Sedimentation with chemical addition (alum)			0[d,e]	-[e]	III.4.3
Activated sludge	63	1,850			III.5.1
Steam stripping			97->99	33,000	III.5.5
Solvent extraction			87->99	84,000	III.5.6
Powdered activated carbon adsorption	99	12	81[d]	190,000[d]	III.6.2
Granular activated carbon adsorption			>86->99	230,000	III.6.1

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

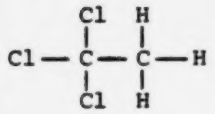
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 44-1 - 44-10.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 1,1,1-Trichloroethane

Formula:



$$\begin{array}{ccccccc} & & Cl & & H & & \\ & & | & & | & & \\ Cl & - & C & - & C & - & H \\ & & | & & | & & \\ & & Cl & & H & & \end{array}$$

Alternate Names: Methyl chloroform,
Chlorotene, Genklene,
Baltana

CAS #: 71-55-6

Physical, Chemical, and Biological Properties [1, 2]

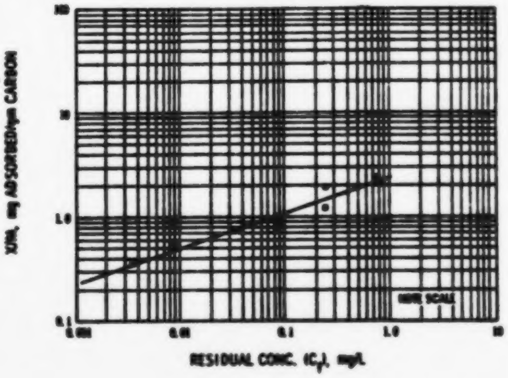
mol. wt.: 133.4 m.p., °C: -30.4 b.p. (760 torr), °C: 74.1
vapor pressure (20°C), torr: 96.0
solubility in water (20°C), mg/L: 950
log octanol/water partition coefficient: 2.17
Henry's law constant: 4.92×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Information lacking, does not appear to be a major aquatic fate; photodissociation to chlorine atoms and chlorine oxides in stratosphere is predicted
oxidation: Information lacking, probably not important aquatic fate; slow photooxidation in troposphere to trichloroacetaldehyde and subsequently trichloroacetic acid is the predominant fate
hydrolysis: Slow hydrolysis to acetic and hydrochloric acids and vinylidene chloride suggested
volatilization: Volatilization to the atmosphere is rapid and is a major transport process
sorption: Information lacking, may be important fate mechanism
biological processes: Information lacking, some bioaccumulation and biodegradation indicated
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 3,600 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF 1,1,1-TRICHLOROETHANE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	10	2.5	0	0.066	0.0094
Textile mills	NA	17	7.8[d]	0.00033	0.22	0.014
Timber products process	BDL	90	30[e]	0	1.4	0.0026
Paint and ink formulation	ND	1,000	350		0.016	0.00056
Gum and wood chemicals[f]	BDL	830	280	0.0025	2.1	0.46
Rubber processing	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	<1	414	<106	0	NA	3.2
Auto and other laundries	ND	6,600	520	0.00047	0.73	0.11
Pharmaceutical manufacturing	ND	130	10	0	0.068	0.0092
Ore mining and dressing	0.63	0.63	0.63	0	NA	0.023
Steam electric power generating (condenser cooling system)	13	26	15	0.0008	0.017	0.0036
Coil coating	ND	1,300	12	0.0006	0.022	0.0022
Foundries	ND	16,000	1,400	0	9.4	3.8
Leather tanning and finishing	ND	NA	1.4	0	NA	0.0021
Iron and steel manufacturing	NA	420	44	0	NA	7.9
Nonferrous metals manufacturing	ND	40	3.6	0	NA	0.19

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF 1,1,1-TRICHLOROETHANE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<3.1	0	0.082	0.012
Textile mills	NA	5^d	5^d	2.1×10^{-5}	0.14	0.00090
Paint and ink formulation	ND	560	89	0	0.0041	0.00014
Gum and wood chemicals	NA	NA	NA	NA	NA	NA
Timber products processing	NA	7,100	7,100	0.0014	6.1	0.23
Rubber processing	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	<1	4	<2	0	NA	0.060
Auto and other laundries	ND^d	ND^d	ND^d	$-^e$	$-^e$	$-^e$
Pharmaceutical manufacturing	ND	360,000	25,800	0	180	24
Nonferrous metals manufacturing	ND	10	1.5	0	NA	0.08
Iron and steel manufacturing	NA	50	10	0	NA	1.8

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,1,1-TRICHLOROETHANE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	50^{d}	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			22d	14^{d}	III.4.5
Gas flotation with chemical addition (polymer)			>4->9	<6	III.4.5
Gas flotation with chemical addition (alum, polymer)			74d	860^{d}	III.4.5
Filtration			67-94	710	III.4.6
Sedimentation			30->57	<19	III.4.2
Sedimentation with chemical addition (lime, polymer)			0d,e	-^{e}	III.4.3
Sedimentation with chemical addition (alum, polymer)			46-93	69	III.4.3
Aerated lagoons			96^{d}	22^{d}	III.5.3
Steam stripping			9^{d}	42,000^{d}	III.5.5
Activated sludge	83	850	74->99	<2.4	III.5.1
Granular activated carbon adsorption			>99^{d}	<10^{d}	III.6.1
Powdered activated carbon adsorption	~100	3.5			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

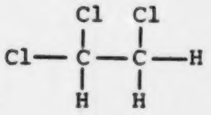
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 45-1 - 45-12.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 1,1,2-Trichloroethane

Formula:



$$Cl-\overset{\displaystyle Cl}{\underset{\displaystyle H}{C}}-\overset{\displaystyle Cl}{\underset{\displaystyle H}{C}}-H$$

Alternate Names: Vinyl trichloride

CAS #: 79-00-5

Physical, Chemical, and Biological Properties [1, 2]

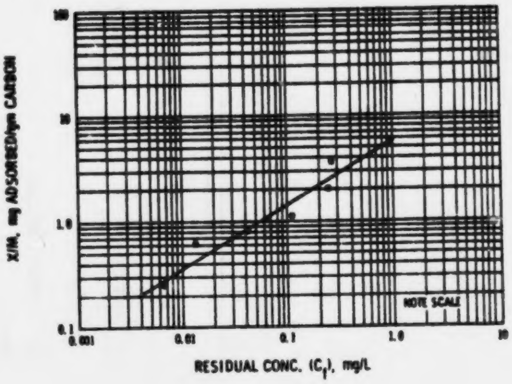
mol. wt.: 133.4 m.p., °C: -36.5 b.p. (760 torr), °C: 113
vapor pressure (20°C), torr: 19
solubility in water (20°C), mg/L: 4,500
log octanol/water partition coefficient: 2.17
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: No data available pertaining to rate of photolysis in aquatic environment; photodissociation in stratosphere expected to be important fate
oxidation: Oxidation in aquatic systems not expected to be important fate; photooxidation in the troposphere is probably the predominant fate
hydrolysis: Although the vapor pressure of this compound is lower than that of 1,1,1-trichloriethane, volatilization probably serves as the primary transport process
volatilization: Some volatilization occurs, importance as a fate mechanism unknown
sorption: Information lacking, may be important fate mechanism
biological processes: Information unavailable
other reactions/interactions: Information unavailable

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 1,500 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF 1,1,2-TRICHLOROETHANE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	BDL	BDL	BDL
Paint and ink formulation	ND	2,800	290	0	0.013	0.00046
Rubber processing	NA	<0.1[d]	<0.1[d]	2×10^{-8}	8.6×10^{-5}	3.3×10^{-6}
Auto and other laundries	ND	3,000	1,500	0.0014	2.1	0.32
Pharmaceutical manufacturing	ND	1,300	95	0	0.65	0.087
Leather tanning and finishing	ND	NA	1.4	0	NA	0.0021
Foundries	ND	NA	10	0	0.067	0.027
Nonferrous metals manufacturing	ND	29	1.2	0	NA	0.064

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF 1,1,2-TRICHLOROETHANE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.2	0	0.0053	0.00076
Paint and ink formulation	ND	2,100	93	0	0.0043	0.00015
Rubber processing	NA	<1	<0.55	1.1×10^{-7}	0.00047	1.8×10^{-5}
Pharmaceutical manufacturing	ND	890	64	0	0.43	0.06
Nonferrous metals manufacturing	ND	8.5	1.7	0	NA	0.09

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,1,2-TRICHLOROETHANE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Filtration			$0^{d,e}$	$-^{e}$	III.4.6
Sedimentation with chemical addition (alum, polymer)			$0^{d,e}$	$-^{e}$	III.4.3
Steam stripping			>99	<48	III.5.5
Solvent extraction			90-95	16,000	III.5.6
Activated sludge	44	2,800	$>9^{d}$	$<10^{d}$	III.5.1
Granular activated carbon adsorption			$>99^{d}$	$<10^{d}$	III.6.1
Powdered activated carbon adsorption	~100	6			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

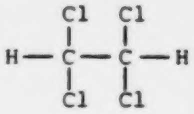
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 46-1 - 46-9.

2. Interscience Encyclopedia, Inc. Encyclopedia of Chemical Technology, Volume 5, 3rd Edition. New York, New York, 1978. p. 732.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 1,1,2,2-Tetrachloroethane

Formula:



$$H-\overset{\displaystyle Cl}{\underset{\displaystyle Cl}{C}}-\overset{\displaystyle Cl}{\underset{\displaystyle Cl}{C}}-H$$

Alternate Names: sym-Tetrachloroethane,
Acetylene tetrachloride

CAS #: 79-34-5

Physical, Chemical, and Biological Properties [1]

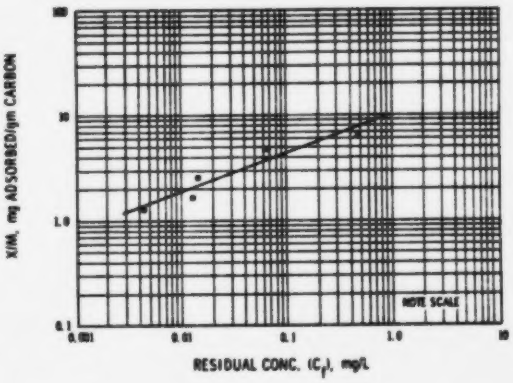
mol. wt.: 167.8 m.p., °C: -446 b.p. (760 torr), °C: 146
vapor pressure (20°C), torr: 5
solubility in water (20°C), mg/L: 2,900
log octanol/water partition coefficient: 2.56
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Probably not significant in aquatic environment; photodissociation in stratosphere is probably a significant fate
oxidation: Not important in aquatic environment; photooxidation in the troposphere probably is important
hydrolysis: Too slow to be important
volatilization: Probable primary transport process
sorption: Information not available
biological processes: Information not available
other reactions/interactions: Unknown

Carbon Adsorption Data [2]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 850 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF 1,1,2,2-TETRACHLOROETHANE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	BDL	BDL	BDL
Rubber processing	NA	1.5[d]	1.5[d]	3×10^{-7}	0.0013	4.9×10^{-5}
Pharmaceutical manufacturing	ND	10	2	0	0.014	0.0018
Foundries	ND	NA	18	0	0.12	0.049
Leather tanning and finishing	ND	NA	5.4	0	NA	0.0081
Nonferrous metals manufacturing	ND	35	2.8	0	NA	0.15

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF 1,1,2,2-TETRACHLOROETHANE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.2	0	0.0053	0.00076
Rubber processing	NA	4	1.7	3.4×10^{-7}	0.0015	5.6×10^{-5}
Auto and other laundries	0.7	9	5	4.5×10^{-6}	0.007	0.0010
Pharmaceutical manufacturing	ND	ND	ND	-[d]	-[d]	-[d]
Foundries	18	<20	19	0	0.13	0.051
Iron and steel manufacturing	NA	<10	<10	0	NA	<1.8
Leather tanning and finishing	ND	ND	ND	-[d]	-[d]	-[d]
Nonferrous metals manufacturing	ND	190	10	0	NA	0.53

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,1,2,2-TETRACHLOROETHANE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Filtration			0[d,e]	-[e]	III.4.6
Sedimentation			0[d,e]	-[e]	III.4.2
Sedimentation with chemical addition (alum, lime)			30[d]	35[d]	III.4.3
Steam stripping			40->99	32,000	III.5.5
Solvent extraction			91-99	4,200	III.5.6
Activated sludge	29	3,550	>22->44	<9	III.5.1
Powdered activated carbon adsorption	~100	4.2			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

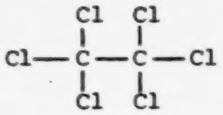
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 47-1 - 47-9.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Hexachloroethane

Formula:



$\mathrm{Cl_3C{-}CCl_3}$

Alternate Names: Perchloroethane,
Carbon hexachloride

CAS #: 67-72-1

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 236.7 m.p., °C: 187 (sealed tube) b.p. (777 torr), °C: 186 (sublimes)

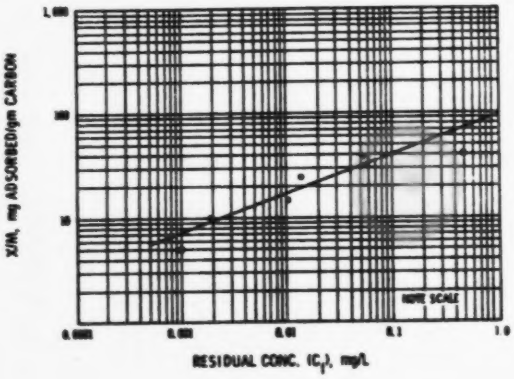
vapor pressure (20°C), torr: 0.4
solubility in water (22°C), mg/L: 50
log octanol/water partition coefficient: 3.34
Henry's law constant: 9.85×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Photodissociation in stratosphere may be important; not important in aquatic environment
oxidation: Not important
hydrolysis: Probably unimportant
volatilization: Some volatilization occurs, importance as a fate mechanism unknown
sorption: No data available
biological processes: High log octanol/water partition coefficient indicates possibility of bioaccumulation
other reactions/interactions: Unknown

Carbon Adsorption Data [4]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 93 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF HEXACHLOROETHANE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	BDL	BDL	BDL
Inorganic chemicals manufacturing	NA	90[e]	NA	0	5.6	1.1
Nonferrous metals manufacturing	ND	23	1.5	0	NA	0.080

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF HEXACHLOROETHANE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<0.4	0	0.011	0.0015

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR HEXACHLOROETHANE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Activated sludge	~100	<50			III.5.1
Powdered activated carbon adsorption	90	0.079			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 48-1 - 48-7.

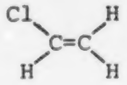
2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-293.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Vinyl chloride

Formula:



Alternate Names: Chloroethene, Monochloroethylene, Monovinylchloride, MVC, Chloroethylene

CAS #: 75-01-4

Physical, Chemical, and Biological Properties [1]

mol. wt.: 62.50 m.p., °C: -160 b.p. (760 torr), °C: -13.4
vapor pressure (25°C), torr: 2,660
solubility in water (25°C), mg/L: 1.1
log octanol/water partition coefficient: 0.60
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Light-induced transformations of vinyl chloride can occur through indirect photolysis in water containing photosensitizers, direct photolysis insignificant
oxidation: Experiments indicate that vinyl chloride is decomposed in water by reactive radicals, when present in sufficient concentration; in the troposphere rapid oxidation by hydroxyl radicals occurs yielding as end-products hydrogen chloride and carbon monoxide
hydrolysis: Due to rapid volatilization, hydrolysis should not be a significant aquatic fate
volatilization: Volatilization to the atmosphere is rapid and is a major transport process
sorption: Sorption by inorganic and organic materials not expected to be important fate mechanism
biological processes: Biodegradation and bioaccumulation are not believed to be important fate processes
other reactions/interactions: Vinyl chloride could be converted to more highly chlorinated compounds in aqueous environment where high concentrations of chlorine/chloride exist

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF VINYL CHLORIDE[a,b]

	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	11[d]	11[d]	0.000046	0.32	0.020

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF VINYL CHLORIDE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	NA	NA	NA	NA	NA

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR VINYL CHLORIDE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Granular activated carbon adsorption			0[d,e]	-[e]	III.6.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

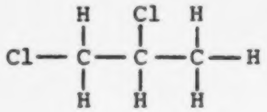
[e] Actual data indicate negative removal.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 49-1 - 49-10.

Compound: 1,2-Dichloropropane

Formula:



$Cl-\underset{H}{\overset{H}{C}}-\underset{H}{\overset{Cl}{C}}-\underset{H}{\overset{H}{C}}-H$

Alternate Names: Propylene chloride,
Propylene dichloride

CAS #: 78-87-5

Physical, Chemical, and Biological Properties [1, 2]

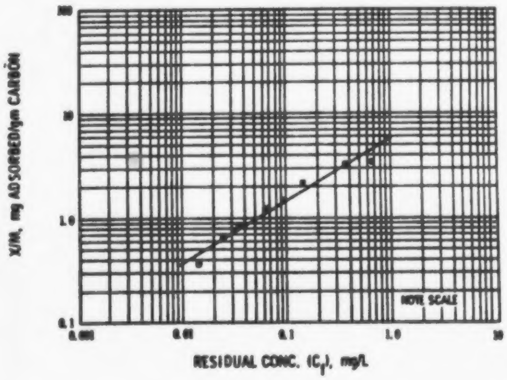
mol. wt.: 113.0   m.p., °C: -100   b.p. (760 torr), °C: 96.8
vapor pressure (20°C), torr: 42
solubility in water (20°C), mg/L: 2,700
log octanol/water partition coefficient: 2.28
Henry's law constant: 2.82×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Can occur in atmosphere
oxidation: Photooxidation in troposphere is probably important
hydrolysis: Probably cannot compete with volatilization
volatilization: Some volatilization occurs, probable important transport process
sorption: Importance unknown, may be important fate mechanism
biological processes: Importance unknown, this compound can be used as a carbon source by several soil bacteria
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 1,500 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF 1,2-DICHLOROPROPANE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	100[d]	100[d]	0.00042	2.9	0.18
Paint and ink formulation	ND	970	180	0	0.0083	0.00029

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF 1,2-DICHLOROPROPANE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Paint and ink formulation	ND	400	210	0	0.0097	0.00034
Textile mills	NA	NA	NA	NA	NA	NA

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,2-DICHLOROPROPANE^{a,b}

Treatment process^{a}	Synthetic wastewater Removal range,^{c} %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,^{c} %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Filtration			0^{d,e}	-^{e}	III.4.6
Sedimentation with chemical addition (alum, lime)			59^{d}	400^{d}	III.4.3
Activated sludge	89	550	>68->82	<5.4	III.5.1
Powdered activated carbon adsorption	99	15	93^{d}	70,000^{d}	III.6.2
Granular activated carbon adsorption			>64->99	5.4	III.6.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

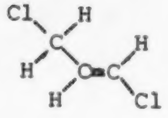
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 54-1 - 54-5.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

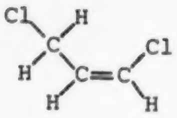
3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 1,3-Dichloropropene

Formula:



(*trans*)



(*cis*)

Alternate Names: 1,3-Dichloropropylene

CAS #: 542-75-6

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 111.0 m.p., °C: Not available b.p. (760 torr), °C: 104 (*cis* isomer); 112 (*trans* isomer)
vapor pressure (20°C), torr: 25
solubility in water (25°C), mg/L: 2,700 (*cis* isomer); 2,800 (*trans* isomer)
log octanol/water partition coefficient: 1.98
Henry's law constant: 3.55×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: No data available; direct photolysis of this compound in water expected to be slow
oxidation: Photooxidation in the troposphere is probably the predominant fate process
hydrolysis: Slow hydrolysis to 3-chloroallyl alcohol occurs, may be important
volatilization: Volatilization to the atmosphere should be a major transport process
sorption: Information not available
biological processes: Biodegradation of this compound is possible; amount of bioaccumulation unknown
other reactions/interactions: Unknown

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF 1,3-DICHLOROPROPENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pharmaceutical manufacturing	ND	ND	ND	-[d]	-[d]	-[d]
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

INDUSTRIAL OCCURRENCE OF 1,3-DICHLOROPROPENE[a,b]

	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pharmaceutical manufacturing	ND	ND	ND	-[d]	-[d]	-[d]

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,3-DICHLOROPROPENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Activated sludge	85	750	0[d,e]	-[e]	III.5.1

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

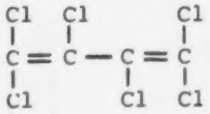
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 55-1 - 55-7.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

Compound: Hexachlorobutadiene

Formula:



$$\mathrm{Cl_2C{=}C(Cl){-}C(Cl){=}CCl_2}$$

Alternate Names: HCBD, Hexachloro-1,3-butadiene

CAS #: 87-68-3

Physical, Chemical, and Biological Properties [1, 2]

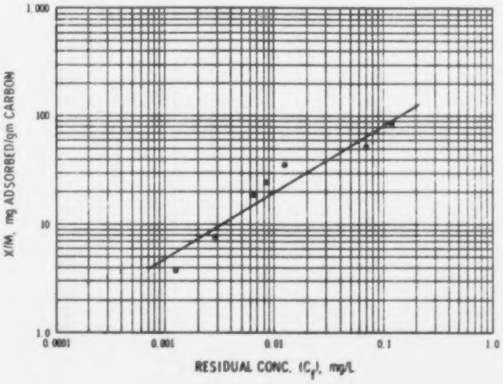
mol. wt.: 260.8 m.p., °C: -21 b.p. (760 torr), °C: 215
vapor pressure (20°C), torr: 0.15
solubility in water (20°C), mg/L: 2
log octanol/water partition coefficient: 3.74
Henry's law constant: 10.3×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Absorption of sunlight too weak to make photolysis important
oxidation: Lack of information probably indicates unimportance
hydrolysis: Lack of information probably indicates unimportance
volatilization: Low vapor pressure precludes volatilization as an important transport process
sorption: Adsorbed by organic materials very strongly
biological processes: Bioaccumulation occurs in some aquatic organisms; no information on biodegradation
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: 7.3
type of carbon: Filtrasorb-300
adsorbability: 25 mg/L carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF HEXACHLOROBUTADIENE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF HEXACHLOROBUTADIENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR HEXACHLOROBUTADIENE[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., μg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., μg/L	Volume III references, Section numbers
Activated sludge	~100	<50			III.5.1
Powdered activated carbon adsorption	~100	2			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

REFERENCES

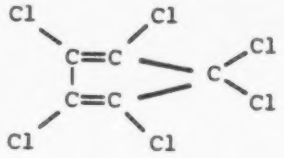
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 56-1 - 56-7.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Hexachlorocyclopentadiene

Formula:



Alternate Names: HCCPD, Perchlorocyclopentadiene

CAS #: 77-47-4

Physical, Chemical, and Biological Properties [1, 2]

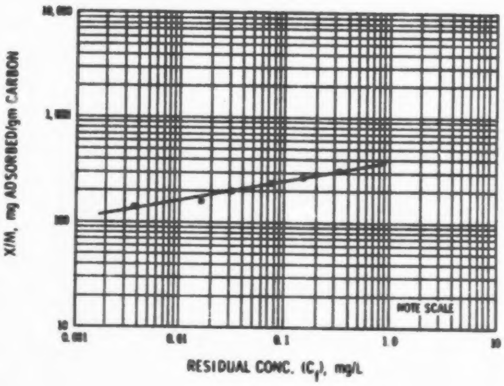
mol. wt.: 272.8 m.p., °C: -9.9 b.p. (760 torr), °C: 239
vapor pressure (25°C), torr: 0.081
solubility in water (25°C), mg/L: 0.805
log octanol/water partition coefficient: 3.99
Henry's law constant: 16.4×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Near-surface photolysis is an important process
oxidation: Lack of data probably indicates unimportance
hydrolysis: Acid-catalyzed hydrolysis to tetrachlorocyclopentadienone could occur only if HCCPD is adsorbed onto clay surface
volatilization: Appears to be important in flowing waters
sorption: Based on data for hexachlorobutadiene, adsorption onto organic matter may be important
biological processes: Bioaccumulated in many organisms/Weak biodegradation to tetrachlorocyclopentadienone hydrate
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 24 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF HEXACHLOROCYCLOPENTADIENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF HEXACHLOROCYCLOPENTADIENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries	NA	<20[d]	<20[d]	0	0.13	0.054

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR HEXACHLOROCYCLOPENTADIENE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Activated sludge	~100	<50			III.5.1
Powdered activated carbon adsorption	~100	4			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

REFERENCES

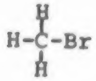
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 57-1 - 57-7.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Methyl bromide

Formula:



$H-\overset{H}{\underset{H}{C}}-Br$

Alternate Names: Bromomethane, Terabol,
Monobromomethane,
Embafume

CAS #: 74-83-9

Physical, Chemical, and Biological Properties [1]

mol. wt.: 94.94 m.p., °C: -93.6 b.p. (760 torr), °C: 4.6
vapor pressure (20°C), torr: 1,420
solubility in water (20°C), mg/L: 900
log octanol/water partition coefficient: 1.1
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Volatilized methyl bromide should photodissociate above the ozone layer; probably not significant in aquatic systems
oxidation: Atmospheric photooxidation by hydroxyl radicals releases inorganic bromide which is carried down by rain
hydrolysis: Unvolatilized methyl bromide should undergo hydrolysis with a half-life of less than 20 days
volatilization: Rapid volatilization is the dominant transport process
sorption: Too slow to compete with volatilization
biological processes: Not expected to be important/very little data
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF METHYL BROMIDE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pharmaceutical manufacturing	ND	15	3	0	0.02	0.0028

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF METHYL BROMIDE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pharmaceutical manufacturing	ND	ND	ND	-[d]	-[d]	-[d]

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR METHYL BROMIDE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

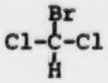
[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 58-1 - 58-7.

Compound: Dichlorobromomethane **Formula:**



$CHBrCl_2$

Alternate Names: Bromodichloromethane

CAS #: 75-27-4

Physical, Chemical, and Biological Properties [1, 2]

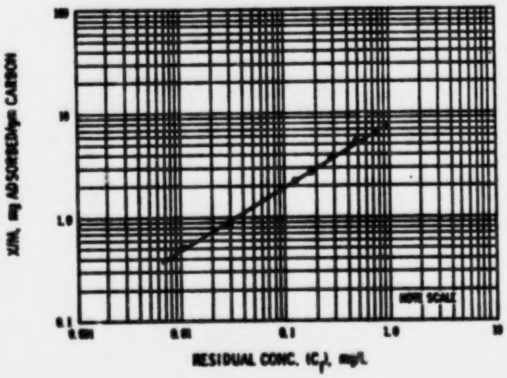
mol. wt.: 163.8 m.p., °C: -57.1 b.p. (760 torr), °C: 90
vapor pressure (20°C), torr: 50
solubility in water (25°C), mg/L: Not available
log octanol/water partition coefficient: 1.88
Henry's law constant: 2.12×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Could be important
oxidation: Could occur
hydrolysis: Too slow to be important
volatilization: Volatilization has been demonstrated, probably an important transport mechanism
sorption: No information, but adsorption onto activated carbon has been demonstrated
biological processes: Moderate potential for bioaccumulation/Metabolization by some aquatic species is known to occur
other reactions/interactions: Dichlorobromomethane may be formed by a haloform reaction following chlorination of drinking water if sufficient bromide is present

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 1,100 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF DICHLOROBROMOMETHANE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	6.6[d]	6.6[d]	2.8×10^{-5}	0.19	0.012
Petroleum refining	NA	110[d]	110[d]	0	10	0.64
Paint and ink formulation	ND	27[e]	27[e]	0	0.0012	4.3×10^{-5}
Auto and other laundries	ND	33	10	9.0×10^{-5}	0.014	0.0021
Pharmaceutical manufacturing	NA	NA	NA	NA	NA	NA
Ore mining and dressing	0.02	0.02	0.02	0	NA	740
Inorganic chemicals manufacturing	NA	310[f]	NA	0	19	3.9
Leather tanning and finishing	ND	NA	<3	0	NA	0.0045
Iron and steel manufacturing	NA	NA	NA	NA	NA	NA

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Detected in only one sample.

[f] Average of maximums reported for various industry segments.

INDUSTRIAL OCCURRENCE OF DICHLOROBROMOMETHANE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Paint and ink formulation	NA	ND	ND	-[d]	-[d]	-[d]
Textile mills	NA	NA	NA	NA	NA	NA
Petroleum refining	NA	NA	NA	NA	NA	NA
Pulp, paper and paperboard mills	0	<1[e]	<1[e]	0	NA	0.030
Auto and other laundries	ND	1.0	0.5	0.45	0.0007	0.00011
Nonferrous metals manufacturing	ND	18	3	0	NA	0.16
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Foundries	NA	23[e]	23[e]	0	0.15	0.062

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DICHLOROBROMOMETHANE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gas flotation with chemical addition (alum, polymer)			>85[d]	<0.9[d]	III.4.5
Activated sludge	59	2,050	0[e]	-[e]	III.5.1
Powdered activated carbon adsorption	99	11			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

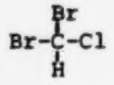
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 59-1 - 59-6.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Chlorodibromomethane

Formula:



$CHBr_2Cl$

Alternate Names: Dibromochloromethane

CAS #: 124-48-1

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 208.3 m.p., °C: <-20 b.p. (48 torr), °C: 119-120
vapor pressure (10.5°C), torr: 15
solubility in water (temp. unknown), mg/L: Not available
log octanol/water partition coefficient: 2.09
Henry's law constant: 0.783×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Could be important
oxidation: Could occur
hydrolysis: Too slow to be important
volatilization: Volatilization has been demonstrated, probable important transport mechanism
sorption: No information, but adsorption onto activated carbon has been demonstrated
biological processes: Moderate potential for bioaccumulation/biodegradation occurs in some organisms
other reactions/interactions: May be formed by haloform reaction after chlorination of water if sufficient bromide is present

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF CHLORODIBROMOMETHANE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Paint and ink formulation[d]	ND	43	43	0	0.0020	6.9×10^{-5}
Timber products processing	NA	NA	NA	NA	NA	NA
Petroleum refining	NA	NA	110[e]	0	10	0.93
Auto and other laundries	ND	12	6	5.4×10^{-6}	0.0084	0.0013
Steam electric power generating (condenser cooling system)	NA	NA	59	0.0031	0.065	0.014
Nonferrous metals manufacturing	ND	81	5.4	0	NA	0.29

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Detected in only one sample.

[e] Median, not average.

INDUSTRIAL OCCURRENCE OF CHLORODIBROMOMETHANE[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Timber products processing	BDL	30	BDL	-[d]	-[d]	-[d]
Petroleum refining	NA	NA	NA	NA	NA	NA
Paint and ink formulation	NA	ND	ND	-[d]	-[d]	-[d]
Auto and other laundries	ND[e]	ND[e]	ND[e]	-[d]	-[d]	-[d]
Nonferrous metals manufacturing	ND	2,800	252	0	NA	13

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CHLORODIBROMOMETHANE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Sedimentation			>77[d]	<10[d]	III.4.2
Sedimentation with chemical addition			>50[d]	<0.3[d]	III.4.3
Activated sludge	39	3,050			III.5.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

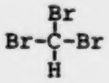
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 60-1 - 60-6.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

Compound: Bromoform

Formula:



$\mathrm{Br{-}\overset{\displaystyle Br}{\underset{\displaystyle H}{C}}{-}Br}$

Alternate Names: Tribromomethane,
Methenyl tribromide

CAS #: 75-25-2

Physical, Chemical, and Biological Properties [1, 2]

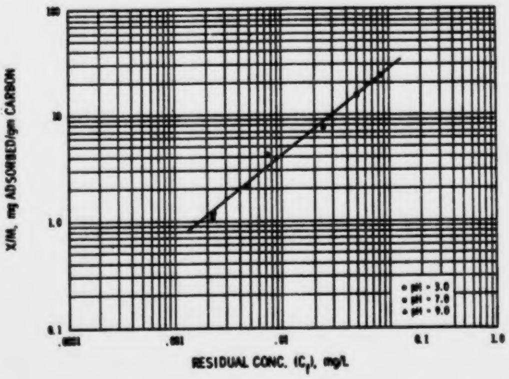
mol. wt.: 252.8   m.p., °C: 8.3   b.p. (760 torr), °C: 150
vapor pressure (34°C), torr: 10
solubility in water, mg/L: 3,010 at 15°C; 3,190 at 30°C
log octanol/water partition coefficient: 2.30
Henry's law constant: 0.532×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Could be important
oxidation: Atmospheric photooxidation by hydroxyl radicals to $COBr_2$ is relatively rapid
hydrolysis: Too slow to be important
volatilization: Volatilization has been demonstrated, could be an important transport process
sorption: No information
biological processes: Slight potential for bioaccumulation/Metabolization is known to occur in some organisms
other reactions/interactions: Possibly produced by haloform reaction

Carbon Adsorption Data [3]

pH: 7.3
type of carbon: Filtrasorb-300
adsorbability: 45 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF BROMOFORM[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pulp, paper and paperboard mills	NA	14[d]	14[d]	0	NA	0.42
Pharmaceutical manufacturing	ND	ND	ND	-[e]	-[e]	-[e]
Steam electric power generating (condenser cooling system)	13	580	210	0.011	0.23	0.05
Nonferrous metals manufacturing	ND	65	6.8	0	NA	0.36

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Mean pollutant concentration below detection limit.

INDUSTRIAL OCCURRENCE OF BROMOFORM[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Pulp, paper and paperboard mil's	NA	3[d]	<3[d]	0	NA	0.090
Pharmaceutical manufacturing	ND	ND	ND	-[e]	-[e]	-[e]
Nonferrous metals manufacturing	ND	44	2.1	0	NA	0.11
Leather tanning and finishing	ND	<10	<5	0	NA	<0.0075

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BROMOFORM[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Activated sludge	48	2,600	0[d,e]	-[e]	III.5.1
Powdered activated carbon adsorption	99	13			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

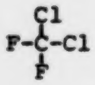
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 61-1 - 61-6.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Dichlorodifluoromethane **Formula:**



$$\mathrm{F{-}\overset{Cl}{\underset{F}{C}}{-}Cl}$$

Alternate Names: Fluorocarbon-12,
Freon-12

CAS #: 75-71-8

Physical, Chemical, and Biological Properties [1]

mol. wt.: 120.9 m.p., °C: -158 b.p. (760 torr), °C: -29.8
vapor pressure (20°C), torr: 4,310
solubility in water (25°C), mg/L: 280
log octanol/water partition coefficient: 2.16
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Volatilized dichlorodifluoromethane is photodissociated to CF_2O and Cl_2 in the stratosphere; probably not important in aquatic systems
oxidation: Not important
hydrolysis: Too slow to be important
volatilization: Very rapid volatilization removes most of the compound from water
sorption: Some potential for adsorption exists, but is greatly inhibited by volatilization
biological processes: Potential for bioaccumulation and transformation is offset by volatilization
other reactions/interactions: Not important

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF DICHLORODIFLUOROMETHANE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF DICHLORODIFLUOROMETHANE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DICHLORODIFLUOROMETHANE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

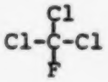
[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 62-1 - 62-8.

Compound: Trichlorofluoromethane **Formula:**



$$\mathrm{Cl{-}\overset{\displaystyle Cl}{\underset{\displaystyle F}{C}}{-}Cl}$$

Alternate Names: Fluorocarbon-11, Freon-11

CAS #: 75-69-4

Physical, Chemical, and Biological Properties [1, 2]

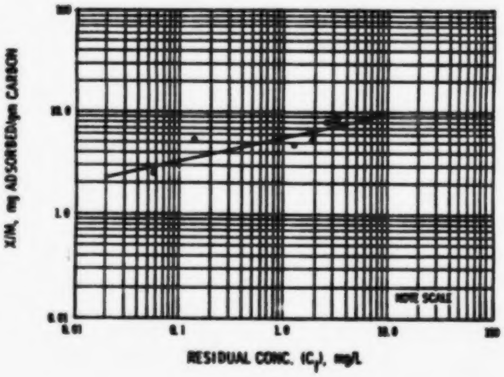
mol. wt.: 137.4 m.p., °C: -111 b.p. (760 torr), °C: 23.8
vapor pressure (20°C), torr: 667
solubility in water (temp. unknown), mg/L: 1,100
log octanol/water partition coefficient: 2.53
Henry's law constant: 58.3×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Volatilized trichlorofluoromethane is eventually photodissociated to CFClO and Cl_2 in the stratosphere; not important in aquatic systems
oxidation: Not expected to be important
hydrolysis: Not important under environmental conditions
volatilization: Rapid volatilization is the major transport process
sorption: Potential for adsorption is greatly hindered by volatilization
biological processes: Rapid volatilization precludes bioaccumulation or degradation
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 1,600 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF TRICHLOROFLUOROMETHANE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	2,100	<5	2.1×10^{-5}	0.14	0.0090
Auto and other laundries	ND	120	120	0.00011	0.17	0.025
Pharmaceutical manufacturing	ND	ND	ND	0	NA	-[e]
Nonferrous metals manufacturing	ND	100	12	0	NA	0.64

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

INDUSTRIAL OCCURRENCE OF TRICHLOROFLUOROMETHANE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	NA	NA	NA	NA	NA
Auto and other laundries	5	150	78	7×10^{-5}	0.11	0.016
Pharmaceutical manufacturing	ND	80	5.7	0	0.0052	0.039

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR TRICHLOROFLUOROMETHANE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gas flotation with chemical addition (alum, polymer)			>50[d]	<2[d]	III.4.5
Filtration			0[d,e]	-[e]	III.4.6
Tertiary polishing lagoons			>79[d]	<10[d]	III.5.3
Activated sludge	73	1,350	19-96	<450	III.5.1
Granular activated carbon adsorption			0[d,e]	-[e]	III.6.1
Powdered activated carbon adsorption	99	56			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

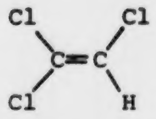
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 63-1 - 63-8.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Trichloroethylene

Formula:



Alternate Names: Trichloroethene,
Ethylene trichloride,
Ethinyl trichloride,
Tri-Clene

CAS #: 79-01-6

Physical, Chemical, and Biological Properties [1, 2]

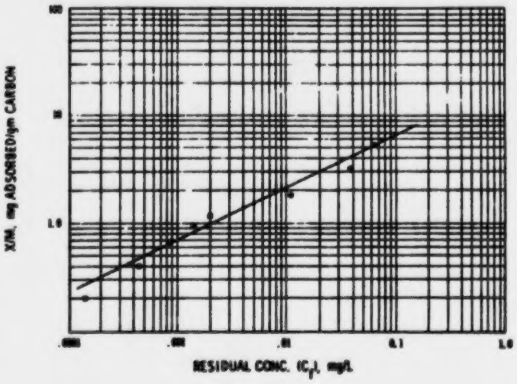
mol. wt.: 131.4 m.p., °C: -73 b.p. (760 torr), °C: 87
vapor pressure (20°C), torr: 57.9
solubility in water (20°C), mg/L: 1,100
log octanol/water partition coefficient: 2.29
Henry's law constant: 11.7×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Tropospheric photoxidation of volatilized trichloroethylene by hydroxyl radicals to phosgene and dichloroacetyl chloride is very rapid, C-Cl bond can photolyze slowly
oxidation: Not important except for photooxidation
hydrolysis: Not important under environmental conditions
volatilization: Rapid volatilization is the major transport process
sorption: Cannot compete with volatilization as a transport process
biological processes: Evidence of bioaccumulation, but not magnification, exists; possible metabolization by higher organisms
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 7.3
type of carbon: Filtrasorb-300
adsorbability: 430 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF TRICHLOROETHYLENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1.4	0	0.037	0.0053
Textile mills	NA	840	47	0.00020	1.3	0.085
Paint and ink formulation	ND	5,000	960	0	0.044	0.0015
Rubber processing	NA	<0.1[d]	<0.1[d]	2×10^{-8}	8.6×10^{-5}	3.3×10^{-6}
Pulp, paper and paperboard mills	NA	NA	NA	NA	NA	NA
Auto and other laundries	ND	800	90	9.1×10^{-5}	0.13	0.019
Pharmaceutical manufacturing	ND	62	8	0	0.054	0.0074
Foundries	ND	280	109	0	0.73	0.29
Leather tanning and finishing	ND	NA	2	0	0.003	NA
Coil coating	ND	310	<10	<0.0005	<0.018	<0.0018
Nonferrous metals manufacturing	ND	900	59	0	NA	3.1
Iron and steel manufacturing	NA	NA	13	0	NA	2.3

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF TRICHLOROETHYLENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1.1	0	0.029	0.0041
Textile mills	NA	87	4.9	2.0×10^{-5}	0.14	0.0088
Paint and ink formulation	ND	300	78	0	0.0036	0.00012
Rubber processing	NA	1,600	550	0.00011	0.47	0.018
Pulp, paper and paperboard mills	<1	6	<3	0	NA	0.090
Auto and other laundries	ND	30	11	1.0×10^{-5}	0.015	0.0023
Pharmaceutical manufacturing	ND	7	0.78	0	0.0053	0.00072
Iron and steel manufacturing	NA	NA	11	0	NA	2.0
Nonferrous metals manufacturing	ND	330	18	0	NA	0.95

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR TRICHLOROETHYLENE[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	>71	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			43-86	18	III.4.5
Filtration			43->90	31	III.4.6
Sedimentation			35-71	34	III.4.2
Sedimentation with chemical addition (polymer)			0[e]	-[e]	III.4.3
Sedimentation with chemical addition (alum, polymer)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (alum)			10[d]	190[d]	III.4.3
Steam stripping			61->99	16,000	III.5.5
Trickling filters			0[d,e]	-[e]	III.5.2
Ozonation			0[d,e]	-[e]	III.6.14
Activated sludge			63->99	9	III.5.1
Granular activated carbon adsorption			29-58	2.8	III.6.1
Reverse osmosis			60[d]	0.4[d]	III.6.4

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negligible removal.

REFERENCES

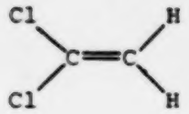
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 52-1 - 52-13.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: 1,1-Dichloroethylene

Formula:



Alternate Names: 1,1-Dichloroethene,
Vinylidine chloride,
Vinylidene chloride,
1,1-DCE

CAS #: 75-35-4

Physical, Chemical, and Biological Properties [1, 2]

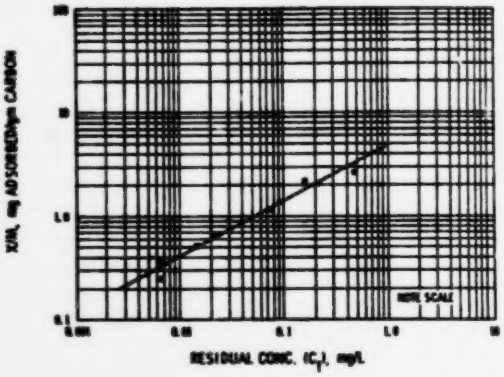
mol. wt.: 96.94 m.p., °C: -122 b.p. (760 torr), °C: 37
vapor pressure (25°C), torr: 591
solubility in water (20°C), mg/L: 5,000
log octanol/water partition coefficient: 1.48
Henry's law constant: 15.0×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Aquatic photodissociation is precluded by volatilization; tropospheric photooxidation precludes stratospheric photodissociation, C-Cl bond can photolyze slowly
oxidation: Tropospheric photooxidation by hydroxyl radicals is rapid and yields a variety of products
hydrolysis: Too slow to be important
volatilization: Rapid volatilization is the main transport process
sorption: Probably cannot compete with volatilization as a transport process
biological processes: Very low potential for bioaccumulation; biodegradation probably too slow to be important
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 1,800 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF 1,1-DICHLOROETHYLENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1.4	0	0.037	0.0053
Textile mills	NA	<5[d]	<5[d]	2.1×10^{-5}	0.14	0.0090
Paint and ink formulation	ND	620	76	0	0.0035	0.00012
Auto and other laundries	ND	23	12	1.1×10^{-5}	0.017	0.0025
Pharmaceutical manufacturing	ND	95	8.9	0	0.061	0.0082
Steam electric power generating (condenser cooling system)	NA	NA	16[e]	0.00084	0.018	0.0039
Coil coating	ND	240	15	0.00075	0.027	0.0072
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	6,100	200	0	NA	11

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Average of medians reported for various industry segments.

INDUSTRIAL OCCURRENCE OF 1,1-DICHLOROETHYLENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1.6	0	0.042	0.0060
Paint and ink formulation	ND	44	20	0	0.00092	3.2×10^{-5}
Textile mills	NA	NA	NA	NA	NA	NA
Pharmaceutical manufacturing	ND	370	27	0	0.18	0.025
Nonferrous metals manufacturing	ND	4,100	86	0	NA	4.6

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,1-DICHLOROETHYLENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Filtration			>52[d]	<2[d]	III.4.6
Sedimentation			0[e]	-[e]	III.4.2
Sedimentation with chemical addition (alum, polymer)			>98[d]	<10[d]	III.4.3
Activated sludge	~100	<50			III.5.1
Powdered activated carbon adsorption	99	7			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

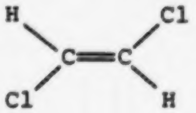
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 50-1 - 50-10.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 1,2-*Trans*-dichloroethylene **Formula:**



Alternate Names: *Trans*-1,2-dichloroethene,
Trans-acetylene dichloride,
Dioform, sym dichloroethylene

CAS #: 540-59-0

Physical, Chemical, and Biological Properties [1, 2]

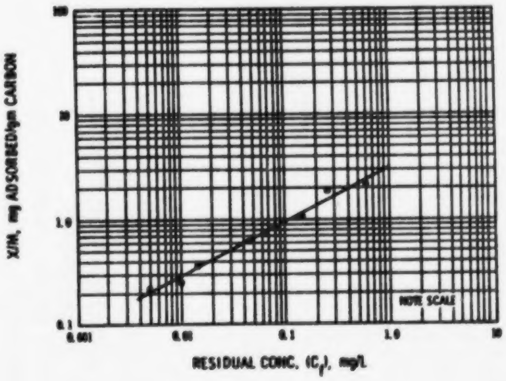
mol. wt.: 96.94 m.p., °C: -50 b.p. (760 torr), °C: 47.5
vapor pressure (]4°C), torr: 200
solubility in water (20°C), mg/L: 6,300
log octanol/water partition coefficient: 1.48
Henry's law constant: 5.32×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Not important except as photooxidation (below), C-Cl bond can photolyze slowly
oxidation: Tropospheric photooxidation by hydroxyl radicals is very rapid and yields a variety of products, probable predominant fate
hydrolysis: Probably too slow to be important
volatilization: Rapid volatilization is the major transport process
sorption: Not important
biological processes: Very low potential for bioaccumulation; biodegradation probably too slow to be important
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 6.7
type of carbon: Filtrasorb-300
adsorbability: 3,000 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF 1,2-*trans*-DICHLOROETHYLENE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Paint and ink formulation	ND	260	72	0	0.0033	0.00011
Rubber processing	NA	NA	NA	NA	NA	NA
Auto and other laundries	ND	460	230	0.00021	0.32	0.048
Pharmaceutical manufacturing	ND	ND	ND	–[e]	–[e]	–[e]
Steam electric power generating (condenser cooling system)	NA	NA	11[d]	0.00058	0.012	0.0026
Coil coating	ND	82	<10	<0.0005	<0.018	<0.0048
Foundries	ND	NA	<6	0	<0.75	<0.15
Leather tanning and finishing	ND	NA	6	0	NA	0.009
Iron and steel manufacturing	ND	<10	8	0	NA	1.4
Nonferrous metals manufacturing	ND	480	17	0	NA	0.90

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Average of medians reported for various industry segments.

[e] Mean pollutant concentration below detection limit.

INDUSTRIAL OCCURRENCE OF 1,2-*trans*-DICHLOROETHYLENE[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Paint and ink formulation	ND	190	50	0	0.0023	8.0×10^{-5}
Rubber processing	NA	16[d]	16[d]	3.2×10^{-6}	0.014	0.00053
Pharmaceutical manufacturing	ND	550	140	0	0.95	0.13
Foundries	NA	<20[d]	<20[d]	0	<0.13	<0.054
Nonferrous metals manufacturing	ND	7.5	4.4	0	NA	0.23
Iron and steel manufacturing	NA	<10	8	0	NA	1.4

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 1,2- -DICHLOROETHYLENE [a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	~20[d]	III.4.1
Filtration			0[d,e]	-[e]	III.4.1
Sedimentation			0[e]	-[e]	III.4.2
Sedimentation with chemical addition (polymer)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (alum, polymer)			28[d]	190[d]	III.4.3
Activated sludge	95	250			III.5.1
Steam stripping			76->99	340,000	III.5.5
Powdered activated carbon adsorption	~100	5			III.6.2
Ozonation			0[d,e]	-[e]	III.6.14

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

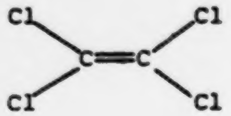
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 51-1 - 51-10.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Tetrachloroethylene

Formula:



Alternate Names: Tetrachloroethene,
Ethylene tetrachloride,
Perchloroethylene

CAS #: 127-18-4

Physical, Chemical, and Biological Properties [1, 2]

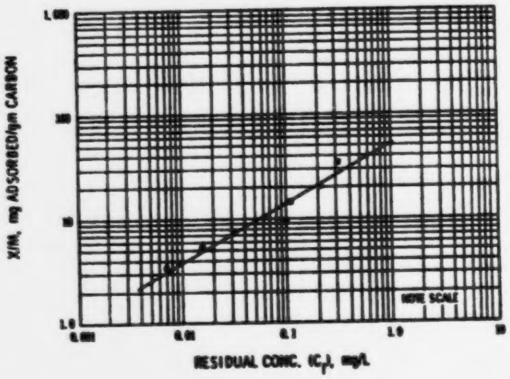
mol. wt.: 165.8 m.p., °C: -22.7 b.p. (760 torr), °C: 121
vapor pressure (20°C), torr: 14
solubility in water (20°C), mg/L: 150
log octanol/water partition coefficient: 2.88
Henry's law constant: 28.7×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Not important except as photooxidation (below), C-Cl bond can photolyze slowly
oxidation: Tropospheric photooxidation by hydroxyl radicals yields Trichloroacetyl chloride and phosgene, predominant fate
hydrolysis: Probably too slow to be important
volatilization: Rapid volatilization is the primary transport process
sorption: Too slow to compete with volatilization
biological processes: Moderate potential for bioaccumulation; possible biodegradation by higher organisms
other reactions/interactions: Not important

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 180 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF TETRACHLOROETHYLENE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	BDL	BDL	BDL
Textile mills	NA	2,100	<5	2.1×10^{-5}	0.14	0.0090
Petroleum refining	NA	<50[d]	<50[d]	0	4.6	0.29
Paint and ink formulation	ND	4,900	920	0	0.042	0.0015
Pulp, paper and paperboard mills	NA	NA	NA	NA	NA	NA
Auto and other laundries	ND	93,000	9,600	0.0086	13	2.1
Pharmaceutical manufacturing	ND	36	3.5	0	0.024	0.0032
Ore mining and dressing	ND	ND	ND	BDL	BDL	BDL
Steam electric power generating (condenser cooling)	NA	NA	78[e]	0.0041	0.086	0.019
Inorganic chemicals manufacturing	NA	196[f]	NA	0	2.5	12
Coil coating	<10[d]	<10[d]	<10[d]	0.0005	0.018	0.0048
Foundries	ND	370	70	0	0.47	0.032
Leather tanning and finishing	ND	NA	12	0	NA	0.018
Nonferrous metals manufacturing	ND	310	14	0	NA	0.74
Iron and steel manufacturing	NA	1,100	42	0	NA	7.6

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

[e] Average of medians reported for various industry segments.

[f] Average of maximum reported for various industry segments.

INDUSTRIAL OCCURRENCE OF TETRACHLOROETHYLENE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.2	0	0.0053	0.00076
Textile mills	NA	17	11[d]	4.6×10^{-5}	0.32	0.020
Petroleum refining	NA	10[e]	10[e]	0	0.93	0.058
Paint and ink formulation	ND	700	190	0	0.0087	0.00030
Pulp, paper and paperboard mills	<1	4	<2	0	NA	0.060
Auto and other laundries	2	1,000	340	0.00030	0.476	0.071
Pharmaceutical manufacturing	ND	ND	ND	-[f]	-[f]	-[f]
Foundries	1.0	210	54	0	0.36	0.15
Iron and steel manufacturing	NA	51	16	0	NA	2.9
Nonferrous metals manufacturing	ND	190	15	0	NA	0.80

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Median, not average.

[e] One sample.

[f] Mean pollutant concentration below detection limit.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR TETRACHLOROETHYLENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	>40	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			23-94	580	III.4.5
Gas flotation with chemical addition (polymer)			0[d,e]	-[e]	III.4.5
Gas flotation with chemical addition (alum, polymer)			>10[d]	<0.9[d]	III.4.5
Filtration			30->99	49	III.4.6
Sedimentation			34-76	<23	III.4.2
Sedimentation with chemical addition (alum, lime)			95[d]	13[d]	III.4.3
Sedimentation with chemical addition (lime, polymer)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (alum, polymer)			15->44	270	III.4.3
Sedimentation with chemical addition (alum)			0[d,e]	-[e]	III.4.3
Sedimentation with chemical addition (lime)			0[d,e]	-[e]	III.4.3
Aerated lagoons			>60[d]	<10[d]	III.5.3
Steam stripping			78->99	2,300	III.5.5
Activated sludge	87	650	75->99	<7	III.5.1
Granular activated carbon adsorption			68[d]	32[d]	III.6.1
Powdered activated carbon adsorption	99	7			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

REFERENCES

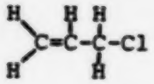
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 53-1 - 53-13.

2. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Allyl chloride

Formula:



Alternate Names: Chloroallylene, 3-Chloro-1-propene, 3-Chloropropylene, 2-Propenyl chloride

CAS #: 107-05-1

Physical, Chemical, and Biological Properties [1]

mol. wt.: 76.53   m.p., °C: -134   b.p. (760 torr), °C: 44-45
vapor pressure (25°C), torr: 368
solubility in water (25°C), mg/L: Slightly soluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate:

photolysis: Photooxidation probable important atmospheric fate
oxidation: Probable important atmospheric fate
hydrolysis: Slow hydrolysis to allyl alcohol
volatilization: Major transport fate
sorption: Information unavailable
biological processes: Information unavailable
other reactions/interactions: Unknown

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF ALLYL CHLORIDE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ALLYL CHLORIDE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ALLYL CHLORIDE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

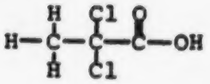
[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part II, pp. 88, 89.

Compound: 2,2-Dichloropropionic acid **Formula**:



$H-\overset{H}{\underset{H}{C}}-\overset{Cl}{\underset{Cl}{C}}-\overset{O}{\overset{\|}{C}}-OH$

Alternate Names: 2,2-Dichloropropanoic acid

CAS #: 75-99-0

Physical, Chemical, and Biological Properties [1]

mol. wt.: 143 m.p., °C: Not available b.p. (760 torr), °C: 185-190
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Very soluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate:

photolysis: C-Cl bond can photolyze
oxidation: Probably not important
hydrolysis: Slow hydrolysis to α-ketopropionic acid
volatilization: Probably not important
sorption: Information not available
biological processes: Information not available
other reactions/interactions: Unknown

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF 2,2-DICHLOROPROPIONIC ACID[a,b]

	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF 2,2-DICHLOROPROPIONIC ACID[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 2,2-DICHLOROPROPIONIC ACID[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

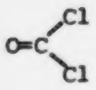
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-454.

Compound: Phosgene

Formula:



Alternate Names: Chloroformyl chloride,
Carbonyl chloride,
Carbonic acid dichloride

CAS #: 75-44-5

Physical, Chemical, and Biological Properties [1]

mol. wt.: 98.92 m.p., °C: -118 b.p. (760 torr), °C: 8.1
vapor pressure (20°C), torr: 1,220
solubility in water (25°C), mg/L: Not available, compound decomposes
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate:

photolysis: Can occur, but cannot compete with hydrolysis
oxidation: Not important
hydrolysis: Rapid hydrolysis to CO_2 and HCl principal fate
volatilization: Probably does not compete with hydrolysis
sorption: Data not available
biological processes: Data not available
other reactions/interactions: Unknown

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF PHOSGENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF PHOSGENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR PHOSGENE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

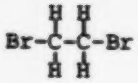
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 534.

Compound: Ethylene dibromide

Formula:



$$Br-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-Br$$

Alternate Names: Ethylene bromide,
1,2-Dibromoethane,
Glycoldibromide, EDB

CAS #: 106-93-4

Physical, Chemical, and Biological Properties [1]

mol. wt.: 187.9 m.p., °C: 9.97 b.p. (760 torr), °C: 132
vapor pressure (20°C), torr: 11
solubility in water (30°C), mg/L: 4,310
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate:

photolysis: C-Br bond can photolyze in atmosphere
oxidation: Photooxidation probably important in atmosphere
hydrolysis: Slow
volatilization: Probable major transport mechanism
sorption: Information not available
biological processes: Information not available
other reactions/interactions: Unknown

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF ETHYLENE DIBROMIDE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ETHYLENE DIBROMIDE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ETHYLENE DIBROMIDE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

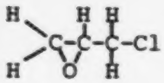
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 316.

Compound: Epichlorohydrin

Formula:



Alternate Names: 3-Chloro-1,2-epoxy-propane, (Chloromethyl) ethylene oxide

CAS #: 106-89-8

Physical, Chemical, and Biological Properties [1]

mol. wt.: 92.53 m.p., °C: -48.0 b.p. (760 torr), °C: 116
vapor pressure (16.6°), torr: 10
solubility in water (25°C), mg/L: Insoluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate:

photolysis: Can occur in atmosphere after volatilization
oxidation: Photooxidation could be important in atmosphere
hydrolysis: Slow
volatilization: Probable major transport mechanism
sorption: Information unavailable
biological processes: Information unavailable
other reactions/interactions: Unknown

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF EPICHLOROHYDRIN[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF EPICHLOROHYDRIN[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR EPICHLOROHYDRIN[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

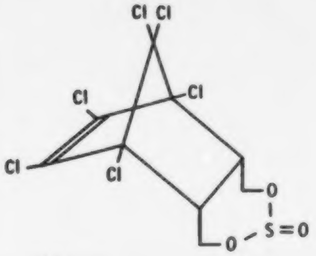
[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part II, pp. 121-123.

Compound: α-Endosulfan **Formula:**



Alternate Names: 6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzo(e)-dioxathiepin-3-oxide

CAS #: 115-29-7

Physical, Chemical, and Biological Properties [1, 2]

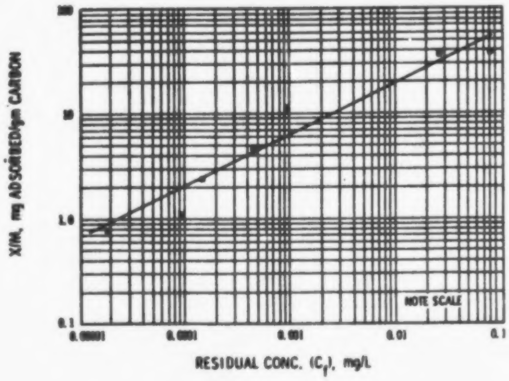
mol. wt.: 407 m.p., °C: 108-110 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: 1×10^{-5}
solubility in water (temp. unknown), mg/L: 0.53
log octanol/water partition coefficient: 3.55
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: C-Cl bond photolysis is possible, could be important
oxidation: Probably not important
hydrolysis: Hydrolysis of sulfite group may be rapid; probably important above pH 7
volatilization: Could be important
sorption: Is an important process
biological processes: Not important
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 46 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF α-ENDOSULFAN[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<1	0	0.029	0.0041
Foundries	ND	NA	2.5	0	0.017	0.007
Iron and steel manufacturing	NA	NA	<10	0	ND	<1.8
Nonferrous metal manufacturing	ND	15	11	0	ND	0.58

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF α-ENDOSULFAN[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Foundries	<5	<5	<5	0	<0.034	<0.014
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.6	0.2	0	NA	0.011

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR α-ENDOSULFAN[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	~100	0.008			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

REFERENCES

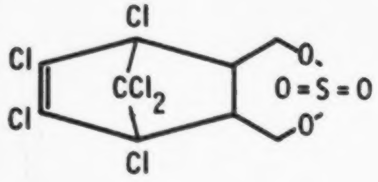
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 27-1 - 27-16.

2. Meister Publishing Co. 1976 Farm Chemicals Handbook. Willoughby, Ohio. 1976. p. D 106.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Endosulfan sulfate

Formula:



Alternate Names: 6,7,8,9.10,10-hexachloro-
1,5,5a,6,9,9a-hexahydro-
6,9-methano-2,4,3-benzodioxa-
thiepin-3,3-dioxide

CAS #: 1031-07-8

Physical, Chemical, and Biological Properties [1, 2]

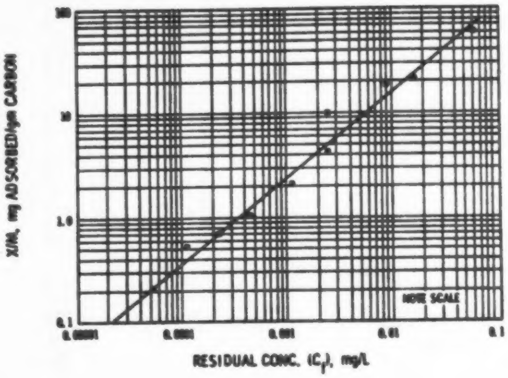
mol. wt.: 423 m.p., °C: 198-201 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: Not available
solubility in water (temp. unknown), mg/L: 0.117
log octanol/water partition coefficient: 3.66
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: No information available
oxidation: Probably not important
hydrolysis: Probably an important process
volatilization: No information available
sorption: No information available
biological processes: No information available
other reactions/interactions: Unknown

Carbon Adsorption Data [2]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 13 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF ENDOSULFAN SULFATE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries	ND	NA	<1.3	0	<0.0087	<0.0035
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metal manufacturing	ND	0.03[d]	0.03[d]	0	NA	0.0016

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection·limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges are reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF ENDOSULFAN SULFATE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries	<5	<5	<5	0	<0.034	<0.014
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.2	0.1	0	NA	0.011

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ENDOSULFAN SULFATE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	~100	0.03			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

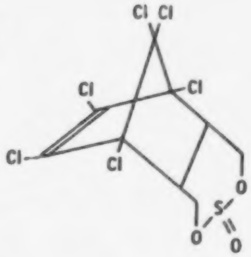
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 27-1 - 27-16.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: β-Endosulfan

Formula:



Alternate Names: 6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzo(e)-dioxathiepin-3-oxide

CAS #: 115-29-7

Physical, Chemical, and Biological Properties [1, 2]

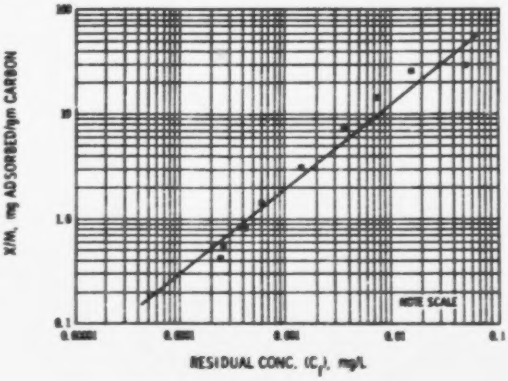
mol. wt.: 407 m.p., °C: 207-209 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: 1×10^{-5}
solubility in water (temp. unknown), mg/L: 0.28
log octanol/water partition coefficient: 3.62
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: C-Cl bond photolysis is possible, could be important
oxidation: Probably not important
hydrolysis: Hydrolysis of sulfite group could be rapid, probably important above pH 7
volatilization: Could be important
sorption: Is an important process
biological processes: Not important
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 15 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF β-ENDOSULFAN[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading, kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<1.1	0	0.029	0.0041
Foundries	ND	NA	<1.7	0	<0.011	<0.0046
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	15	1.6	0	NA	0.085

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF β-ENDOSULFAN[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Foundries	<5	<5	<5	0	<0.034	<0.014
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.2	0.1	0	NA	0.011

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR β-ENDOSULFAN[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	~100	0.2			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

REFERENCES

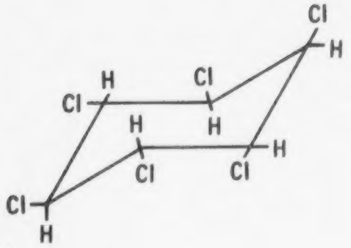
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 27-1 - 27-16.

2. Meister Publishing Co. 1976 Farm Chemicals Handbook. Willoughby, Ohio, 1976. p. D 106.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: α-BHC

Formula:



Alternate Names: Hexachlorocyclohexane,
Benzenehexachloride,
HCCH, HCH, TBH

CAS #: 319-84-6

Physical, Chemical, and Biological Properties [1, 2]

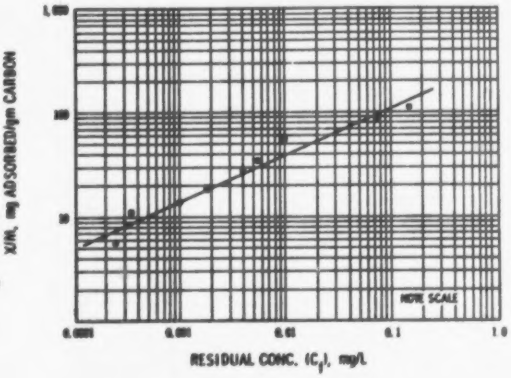
mol. wt.: 290.8 m.p., °C: 157-158 b.p. (760 torr), °C: Decomposes at 288
vapor pressure (20°C), torr: 2.5×10^{-5}
solubility in water (25°C), mg/L: 2.0
log octanol/water partition coefficient: 3.81
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: C-Cl bond photolysis can occur, not important in aquatic systems
oxidation: Not an important process
hydrolysis: Very slow, not important
volatilization: Information contradictory as to how important process is
sorption: Important for transport to anaerobic sediments
biological processes: Biodegradation could be important
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: 5.4
type of carbon: Filtrasorb-300
adsorbability: 30 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.4



INDUSTRIAL OCCURRENCE OF α-BHC[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	BDL	BDL	BDL
Timber products processing	0.001	0.186	NA	0	0.0043	8×10^{-6}
Ore mining and dressing	ND	ND	ND	BDL	BDL	BDL
Foundries	ND	NA	7.2	0	0.019	0.048
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metal manufacturing	ND	0.6	0.23	0	NA	0.012

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF α-BHC[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	0.02[d]	0.02[d]	8.4×10^{-8}	0.00058	3.6×10^{-5}
Timber products processing	NA	NA	NA	NA	NA	NA
Foundries	<5	6	5.2	0	0.035	0.014
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.7	0.1	0	NA	0.0053

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR α-BHC[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Filtration			38-77	4	III.4.6
Granular activated carbon adsorption			>47	<1	III.6.1
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	~100	250			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

REFERENCES

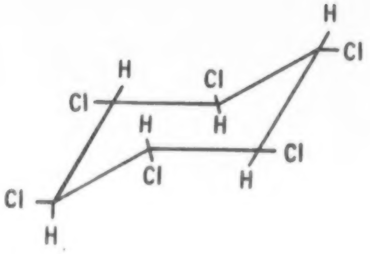
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 31-1 - 31-10.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 365.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: β-BHC

Formula:



Alternate Names: Hexachlorocyclohexane,
Benzene hexachloride,
HCCH, HCH, TBH

CAS #: 319-85-7

Physical, Chemical, and Biological Properties [1, 2]

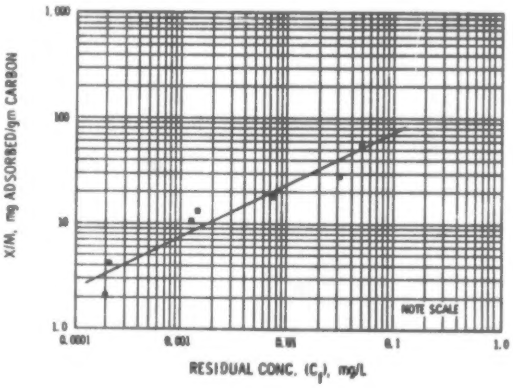
mol. wt.: 290.8 m.p., °C: 309 b.p. (760 torr), °C: sublimes
vapor pressure (20°C), torr: 2.8×10^{-7}
solubility in water (25°C), mg/L: 0.24
log octanol/water partition coefficient: 3.80
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: C-Cl photolysis can occur, not important in aquatic systems
oxidation: Not an important process
hydrolysis: Very slow, not important
volatilization: Information contradictory as to how important process is
sorption: Important for transport to anaerobic sediments
biological processes: Biodegradation could be important
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: 5.4
type of carbon: Filtrasorb-300
adsorbability: 41 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.4



INDUSTRIAL OCCURRENCE OF β-BHC[a,b]

	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Timber products processing	0.001	0.186	NA	0	0.0043	8×10^{-6}
Ore mining and dressing	ND	ND	ND	ND	ND	ND
Foundries	ND	NA	25	0	0.17	0.067
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metal manufacturing	ND	4.5	0.16	0	NA	0.0085

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF β-BHC[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Timber products processing	NA	NA	NA	NA	NA	NA
Foundries	<5	55	12	0	0.08	0.03
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.3	0.1	0	NA	0.0053

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR β-BHC[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Filtration			21[d]	55[d]	III.4.6
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	~100	200			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

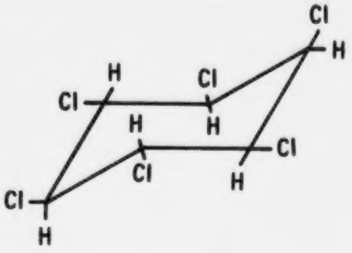
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 31-1 - 31-10.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 365.

3. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: δ-BHC

Formula:



Alternate Names: Benzenehexachloride,
Hexachlorocyclohexane,
HCCH, HCH, TBH

CAS #: 319-86-8

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 290.8 m.p., °C: 138-139 b.p. (760 torr), °C: Not available
vapor pressure (20°C), torr: 1.7×10^{-5}
solubility in water (25°C), mg/L: 31.4
log octanol/water partition coefficient: 4.14
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: C-Cl bond photolysis can occur, not important in aquatic systems
oxidation: Not an important process
hydrolysis: Very slow, not important
volatilization: Information contradictory as to how important process is
sorption: Important for transport to anaerobic sediments
biological processes: Biodegradation could be important
other reactions/interactions: Unknown

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF δ-BHC[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	NA	NA	NA
Timber products processing	0.001	0.186	NA	0	0.0043	8×10^{-6}
Foundries	ND	NA	9.3	0	0.062	0.0025
Nonferrous metals manufacturing	ND	4.0	0.24	0	NA	0.013
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF δ-BHC[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	0.05[d]	0.05[d]	2.1×10^{-7}	0.0014	9.0×10^{-5}
Timber products processing	NA	NA	NA	NA	NA	NA
Foundries	<5	<20	<10	0	<0.067	<0.027
Nonferrous metals manufacturing	ND	0.5	0.2	0	NA	0.011
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR δ-BHC[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Activated sludge	0	NA			III.5.1

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

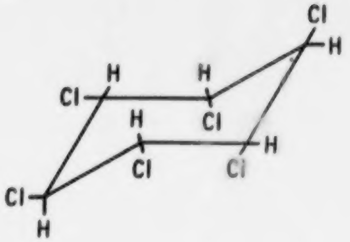
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 31-1 - 31-10.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 365.

Compound: γ-BHC

Formula:



Alternate Names: Hexachlorocyclohexane, Benzenehexachloride, HCCH, HCH, TBH, Main isomer in Lindane (at least 99 percent)

CAS #: 58-89-9

Physical, Chemical, and Biological Properties [1-3]

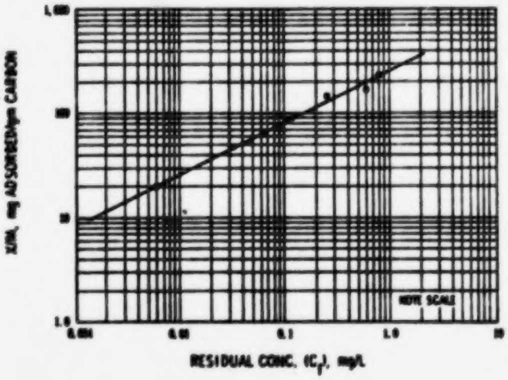
mol. wt.: 290.8 m.p., °C: 112 b.p. (760 torr), °C: Not available
vapor pressure (20°C), torr: 9.4×10^{-6}
solubility in water (25°C), mg/L: 7.5
log octanol/water partition coefficient: 3.72
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: C-Cl bond photolysis can occur, not important in aquatic systems
oxidation: Probably not an important process
hydrolysis: Very slow, not important
volatilization: Not important
sorption: Important for transport to anaerobic sludges
biological processes: Biotransformation most important process
other reactions/interactions: Electrochemical reduction with products of benzene and γ-TCCH has been studied

Carbon Adsorption Data [4]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 35 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF γ-BHC[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	<10	<1.7	0	0.045	0.006
Timber products processing	0.001	0.186	NA	0	0.0043	8×10^{-6}
Ore mining and dressing	ND	ND	ND	BDL	BDL	BDL
Foundries	ND	NA	7	0	0.047	0.020
Nonferrous metals manufacturing	ND	0.2	0.06	0	NA	0.003
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF γ-BHC[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<10	<1.1	0	0.029	0.0041
Timber products processing	NA	NA	NA	NA	NA	NA
Foundries	<5	<20	<6.4	0	<0.043	<0.017
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.1	NA	0	NA	0.0027

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR γ-BHC^{a,b}

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	99	6			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 32-1 - 32-16.

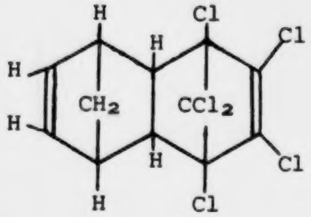
2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 365.

3. Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Aldrin

Formula:



Alternate Names: 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-*oxo*-1,4-*endo*-5,8-dimethanonaphthalene, HHDN

CAS #: 309-00-2

Physical, Chemical, and Biological Properties [1-4]

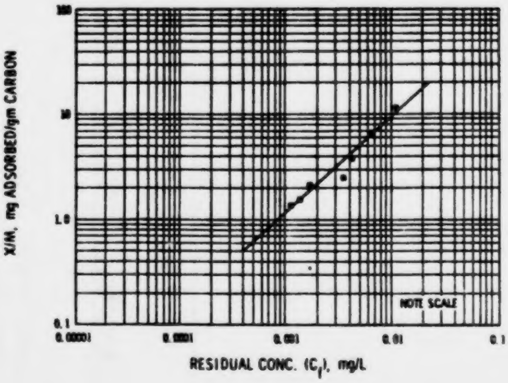
mol. wt.: 64 m.p., °C: 104 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: 6×10^{-6}
solubility in water (20°C), mg/L: 0.011
log octanol/water partition coefficient: Not available
Henry's law constant: 0.496×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Direct photolysis is slow; indirect photolysis may be important
oxidation: Reacts to form dieldrin
hydrolysis: Too slow to be important
volatilization: Probably an important process
sorption: Can be an important process
biological processes: Biotransformation of aldrin to dieldrin is probably the dominant transformation process in aquatic systems
other reactions/interactions: Unknown

Carbon Adsorption Data [5]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 14 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF ALDRIN[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	BDL	BDL	BDL
Timber products processing	NA	0.001[d]	0.001[d]	0	4.6×10^{-5}	8.5×10^{-8}
Ore mining and dressing	<10	<10	<10	0	NA	<0.37
Foundries	ND	NA	<2.5	0	<0.017	<0.0088
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	7	0.6	0	NA	0.032

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

INDUSTRIAL OCCURRENCE OF ALDRIN[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<3.3	<0.3	0	0.0079	0.0011
Timber products processing	NA	NA	NA	NA	NA	NA
Foundries	<5	<20	<7	0	<0.047	<0.019
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.5	0.2	0	NA	0.011

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ALDRIN[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	3[d,e]	III.4.1
Activated sludge	0	NA			III.5.1
Powdered activated sludge adsorption	95	1.2			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Analytical method did not distinguish between aldrin and dieldrin.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 21-1 - 21-13.

2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-104.

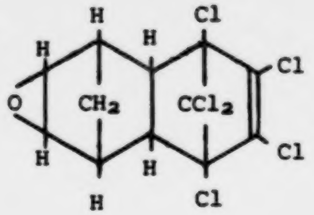
3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Ferguson, T. L., F. J. Bergman, G. R. Cooper, R. T. Li, and F. I. Honea, Determination of Incinerator Operating Conditions Necessary for Safe Disposal of Pesticides. Contract 68-03-0286. U.S. Environmental Protection Agency, Cincinnati, Ohio. July, 1975. p. 145.

5. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Dieldrin

Formula:



Alternate Names: HEOD; 1,2,3,4,10,10-Hexachloro-6,7,-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-*endo*, *exo*-5,8-dimethanonaphthalene

CAS #: 60-57-1

Physical, Chemical, and Biological Properties [1-4]

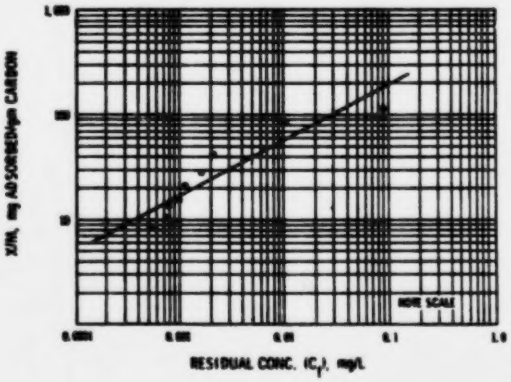
mol. wt.: 381 m.p., °C: 175-176 b.p. (760 torr), °C: Not available
vapor pressure (20°C), torr: 1.78×10^{-7}
solubility in water (25°C), mg/L: 0.20
log octanol/water partition coefficient: Not available
Henry's law constant: 5.8×10^{-5} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Direct photolysis may be important
oxidation: Probably not important
hydrolysis: Hydrolysis of epoxide, too slow to be important
volatilization: Is an important process
sorption: Probably an important process
biological processes: Moderate bioaccumulation
other reactions/interactions: Unknown

Carbon Adsorption Data [5]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 15 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF DIELDRIN[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	NA	NA	NA	NA	NA
Foundries	ND	NA	4	0	0.027	0.011
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.2	0.05	0	NA	0.0026

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF DIELDRIN[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	0.2[d]	0.2[d]	8.4×10^{-7}	0.0058	0.00036
Foundries	<5	<20	<8	0	<0.054	<0.022
Iron and steel manufacturing	NA	NA	<10	0	NA	1.8
Nonferrous metals manufacturing	ND	0.4	0.1	0	NA	0.0053

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DIELDRIN[a,b]

Treatment process[a]	Synthetic wastewater: Removal range,[c] %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal range,[c] %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Gravity oil separation			NA	3[d,e]	III.4.1
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	~100	0.5			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Analytical method did not distinguish between aldrin and dieldrin.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 26-1 - 26-12.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 241.

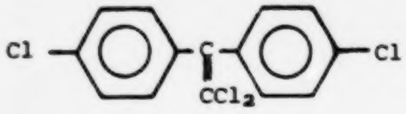
3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 179.

5. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 4,4'-DDE

Formula:



Alternate Names: Dichlorodiphenyl dichloroethylene, 1,1-Dichloro-2,2-bis(*p*-chlorophenyl)-ethylene

CAS #: 72-55-9

Physical, Chemical, and Biological Properties [1, 2]

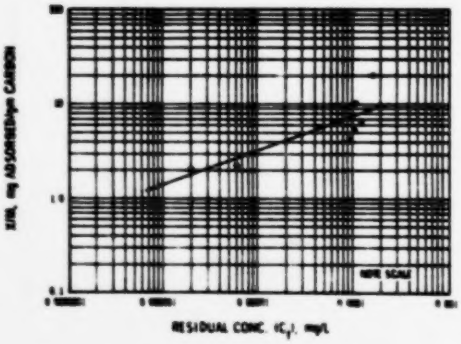
mol. wt.: 318 (calculated)   m.p., °C: 88-90   b.p. (760 torr), °C: Not Available
vapor pressure (20°C), torr: 6.5×10^{-6}
solubility in water (25°C), mg/L: 0.12
log octanol/water partition coefficient: 5.69
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Photooxidation to chlorinated biphenyls and chlorinated benzophenones occurs, could be important in aquatic systems
oxidation: No information available
hydrolysis: Not important
volatilization: Probably an important process
sorption: Is an important process
biological processes: Bioaccumulation is an important process
other reactions/interactions: Not important

Carbon Adsorption Data [2]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 39 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF 4,4'-DDE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Auto and other laundries	ND	≤3.0	NA	1.4×10^{-6}	<0.0021	<0.00032
Foundries	ND	NA	10	0	0.067	0.027
Nonferrous metals manufacturing	ND	0.4	0.06	0	NA	0.032
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF 4,4'-DDE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries	<5	20	7	0	0.047	0.019
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.2	0.06	0	NA	0.0032

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 4,4'-DDE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	~100	0.002			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

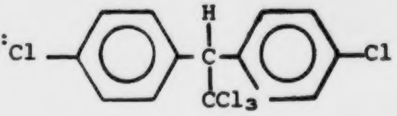
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 24-1 - 24-11.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 4,4'-DDT

Formula:



Alternate Names: Dichloro-diphenyltrichloroethane, Chlorophenotane, Dicophane, 1,1,1-Trichloro-2,2,-bis(*p*-chlorophenyl)ethane

CAS #: 50-29-3

Physical, Chemical, and Biological Properties [1-3]

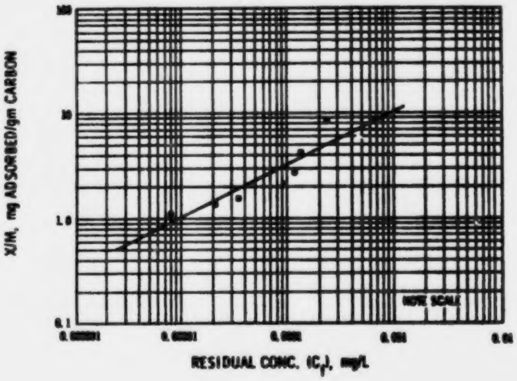
mol. wt.: 354.5 m.p., °C: 108-109 b.p. (760 torr), °C: 185
vapor pressure (20°C), torr: 1.9×10^{-7}
solubility in water (25°C), mg/L: 0.006
log octanol/water partition coefficient: 3.98
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Photooxidation to DDE occurs slowly, indirect photolysis may be important
oxidation: Photooxidation
hydrolysis: May be important under certain conditions
volatilization: Is an important process
sorption: Is an important process
biological processes: Biotransformation and bioaccumulation are important processes
other reactions/interactions: Unknown

Carbon Adsorption Data [4]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 28 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF 4,4-DDT[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Auto and other laundries	ND	≤3.0	NA	1.4×10^{-6}	<0.0021	<0.00032
Foundries	ND	NA	6	0	0.04	0.016
Nonferrous metals manufacturing	ND	1.0	0.04	0	NA	0.0021
Iron and steel manufacturing	NA	NA	<10	0	ND	<1.8
Textile mills	NA	NA	NA	NA	NA	NA

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF 4,4'-DDT[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Textile mills	NA	0.5[d]	0.5[d]	2.1×10^{-6}	0.014	0.00090
Foundries	<5	<20	<6	0	0.04	0.016
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.4	0.07	0	NA	0.0037

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 4,4'-DDT[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Sedimentation with chemical addition (alum, lime)			>52[d]	<1[d]	III.4.3
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	~100	0.008			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 25-1 - 25-22.

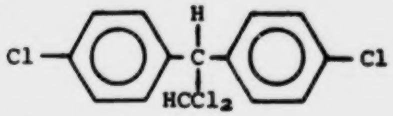
2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-291.

3. Ferguson, T. L., F. J. Bergman, G. R. Cooper, R. T. Li, and F. I. Honea, Determination of Incinerator Operating Conditions Necessary for Safe Disposal of Pesticides. Contract 68-03-0286. U.S. Environmental Protection Agency, Cincinnati, Ohio. July, 1975. p. 118.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: 4,4'-DDD

Formula:



Alternate Names: 1,1-Dichloro-2,2-bis(*p*-chlorophenyl) ethane

CAS #: 72-54-8

Physical, Chemical, and Biological Properties [1, 2]

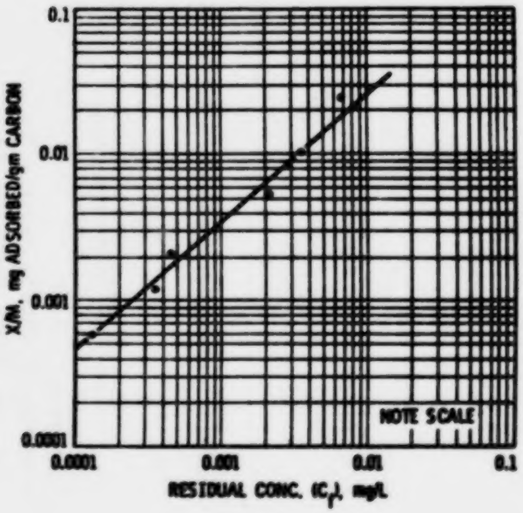
mol. wt.: 320.0   m.p., °C: 112   b.p. (760 torr), °C: Not available
vapor pressure (30°C), torr: 10.2×10^{-7}
solubility in water (25°C), mg/L: 0.02
log octanol/water partition coefficient: 5.98
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Photooxidation to chlorinated biphenyls and benzophenones probable, though not important
oxidation: Not important
hydrolysis: Not important
volatilization: May be an important process
sorption: Is an important process
biological processes: Biotransformation and Bioaccumulation are important processes
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: Not available
type of carbon: Filtrasorb-300
adsorbability: Not available



INDUSTRIAL OCCURRENCE OF 4,4'-DDD[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries	ND	NA	9	0	0.06	0.024
Nonferrous metals manufacturing	ND	0.1	0.1	0	NA	0.0053
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF 4,4'-DDD[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries	<5	<5	<5	0	<0.034	<0.014
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.2	0.1	0	NA	0.0053

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 4,4'-DDD[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Activated sludge	0	NA			III.5.1

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

REFERENCES

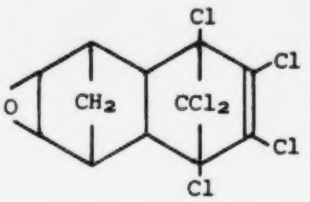
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 23-1 - 23-10.

2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-291.

3. Report on visit of D. Stephan and W. Cawley, U.S. Environmental Protection Agency, to Calgon Environmental Systems Division, Calgon Corporation, Pittsburgh, Pennsylvania, 9 April 1979. 132 pp.

Compound: Endrin

Formula:



Alternate Names: 1,2,3,4,10,-10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-*endo*,*endo*-5,8-dimethanonaphthalene

CAS #: 72-20-8

Physical, Chemical, and Biological Properties [1-3]

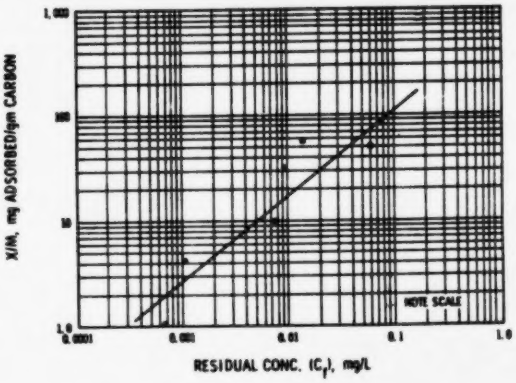
mol. wt.: 380.9 m.p., °C: 200 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: 2×10^{-7}
solubility in water (25°C), mg/L: 0.26
log octanol/water partition coefficient: 5.6 (calculated)
Henry's law constant: Not available
biodegradability: Not available

Probable Fate [1]

photolysis: Photoisomerization occurs, may be important
oxidation: Probably not important
hydrolysis: Hydrolysis of epoxide, too slow to be important
volatilization: Not important
sorption: Information unavailable
biological processes: Bioaccumulation is an important process
other reactions/interactions: Unknown

Carbon Adsorption Data [4]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 14 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF ENDRIN[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries	ND	NA	<1.3	0	<0.0087	<0.0035
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	5.4	0.46	0	NA	0.024

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF ENDRIN[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	NA	0.2	0.1	0	NA	0.0053

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] Median, not average.

[f] Analytical method did not distinguish between benzo(a)pyrene and perylene.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ENDRIN[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., µg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., µg/L	Volume III references, Section numbers
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	99	0.6			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 28-1 - 28-11.

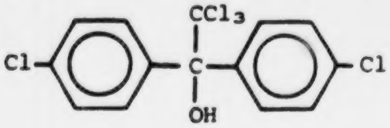
2. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 366.

3. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 190.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Kelthane

Formula:



Alternate Names: Kelthanethanol, Dicofol,
2,2,2-Trichloro-1,1-di-
(4-chlorophenyl) ethanol

CAS #: 115-32-2

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 370.5 m.p., °C: 77-78 b.p. (760 torr), °C: 77-78
vapor pressure (25°C), torr: Not available
solubility in water: Almost totally insoluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF KELTHANE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF KELTHANE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR KELTHANE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

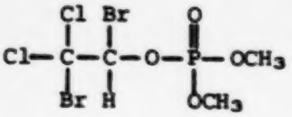
REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part II, pp. 71, 72, 73.

2. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 179.

Compound: Naled

Formula:



$$\mathrm{Cl{-}\underset{Br}{\overset{Cl}{C}}{-}\underset{H}{\overset{Br}{C}}{-}O{-}\underset{OCH_3}{\overset{O}{P}}{-}OCH_3}$$

Alternate Names: Bromex; Orthodibrom; Phosphoric acid, 1,2-dibromo-2,2-Dichloroethyl dimethyl ester

CAS #: 300-76-5

Physical, Chemical, and Biological Properties [1]

mol. wt.: 380.8 m.p., °C: 26 b.p. (0.5 torr), °C: 110
vapor pressure (20°C), torr: 2×10^{-4}
solubility in water: Almost totally insoluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF NALED[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF NALED[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR NALED[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

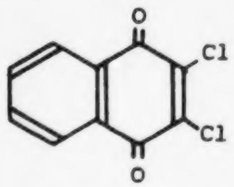
[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part II, pp. 16, 17, 18.

Compound: Dichlone **Formula:**



Alternate Names: Phygon, US Rubber 604,
2,3-Dichloro-1,4-naphthoquinone,
Sanquinon

CAS #: 117-80-6

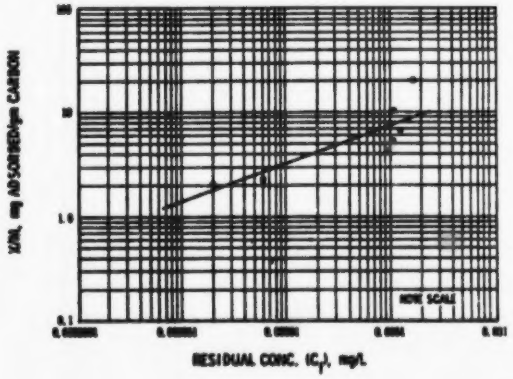
Physical, Chemical, and Biological Properties [1]

mol. wt.: 227.0 m.p., °C: 195 b.p. (2 torr), °C: 275
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Insoluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available



INDUSTRIAL OCCURRENCE OF DICHLONE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF DICHLONE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DICHLONE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

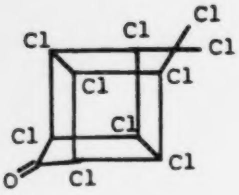
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part II, pp. 81, 82.

Compound: Kepone

Formula:



Alternate Names: 1,1a,3,3a,4,5,5,5a,5b
6-Decachloroctahydro-1,3
4-metheno-2H-cyclobuta(cd)
pentalen-2-one; Merex;
Decachloroketone

CAS #: 143-50-0

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 490.6 m.p., °C: Not available b.p. (760 torr), °C: Sublimes at 350
vapor pressure (25°C), torr: Not available
solubility in water (100°C), mg/L: 4,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

Date: 6/23/80

INDUSTRIAL OCCURRENCE OF KEPONE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF KEPONE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR KEPONE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

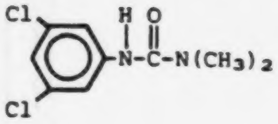
REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 549.

2. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 212.

Compound: Diuron

Formula:



Alternate Names: 3-(3,4-Dichlorophenyl)-1,1-dimethylurea

CAS #: 330-54-1

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 233.1 m.p., °C: 158-159 b.p. (760 torr), °C: Decomposes at 180
vapor pressure (50°C), torr: 0.31×10^{-5}
solubility in water (temp. unknown), mg/L: 42
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF DIURON[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF DIURON[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DIURON[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

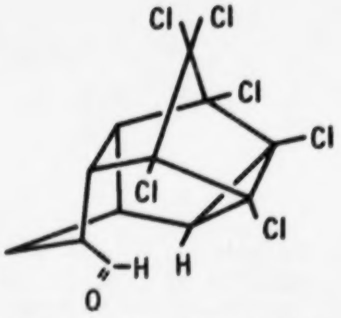
REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 948.

2. Meister Publishing Co. 1976 Farm Chemicals Handbook. Willoughby, Ohio, 1976. pp. D 96, D 97.

3. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 186.

Compound: Endrin aldehyde   Formula:



Alternate Names: 1,2,4-Methenocyclopenta
(c,d)pentalene-r-
carboxaldehyde,2,2a,3,3,4,7-
Lexachlorodecahydro

CAS #: 7421-93-4

Physical, Chemical, and Biological Properties: [1]

mol. wt.: 380.9   m.p., °C: 145-149   b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Not available
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

Date: 6/23/80

INDUSTRIAL OCCURRENCE OF ENDRIN ALDEHYDE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries	ND	20	5.2	0	0.035	0.014
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.9	0.15	0	NA	0.0080

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF ENDRIN ALDEHYDE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Foundries	<5	<20	<9	0	0.06	0.024
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.5	0.15	0	NA	0.08

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ENDRIN ALDEHYDE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

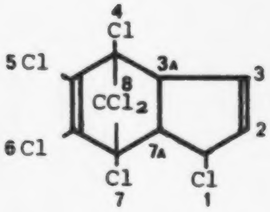
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 28-1 - 28-11.

Compound: Heptachlor

Formula:



Alternate Names: 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene

CAS #: 76-44-8

Physical, Chemical, and Biological Properties [1-5]

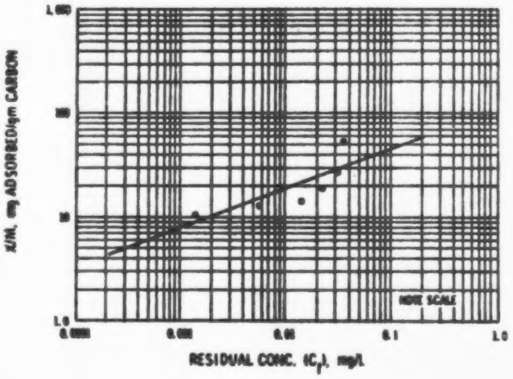
mol. wt.: 373.3 m.p., °C: 95-96 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: 3×10^{-4}
solubility in water (25°C), mg/L: 0.056
log octanol/water partition coefficient: Not available
Henry's law constant: 1.48×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Photoisomerization occurs, rate undetermined
oxidation: Information not available
hydrolysis: Rapid process for heptachlor in solution
volatilization: May be an important process
sorption: Probably an important process, but no reliable data available
biological processes: Will bioaccumulate if not hydrolyzed
other reactions/interactions: Not important

Carbon Adsorption Data [6]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 7 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF HEPTACHLOR[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	BDL	BDL	BDL
Timber products processing	0.001	0.684	NA	0	0.016	2.9×10^{-5}
Auto and other laundries	ND	≤3.0	NA	$<1.4 \times 10^{-6}$	<0.0021	<0.00032
Foundries	ND	NA	<7.5	0	<0.05	<0.02
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.5	0.08	0	NA	0.0042

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF HEPTACHLOR[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<0.8	0	0.021	0.0030
Timber products processing	NA	NA	NA	NA	NA	NA
Foundries	<5	<5	<5	0	0.034	0.014
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.7	0.1	0	NA	0.0053

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR HEPTACHLOR[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Activated sludge	0	NA	76[d]	1.5[d]	III.5.1
Powdered activated carbon adsorption	97	5.8			III.6.2

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 29-1 - 29-17.

2. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 547.

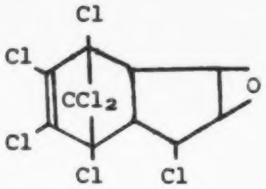
3. Meister Publishing Co. 1976 Farm Chemicals Handbook. Willoughby, Ohio, 1976. p. D 132.

4. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 205.

5. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

6. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Heptachlor epoxide **Formula:**



Alternate Names: 1,4,5,6,7,8,8-Heptachloro-2,3-epoxy-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene

CAS #: 1024-57-3

Physical, Chemical, and Biological Properties [1-3]

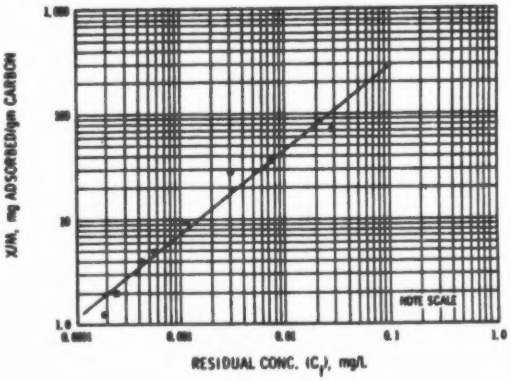
mol. wt.: 389.3 m.p., °C: 157-160 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: 0.35
log octanol/water partition coefficient: Not available
Henry's law constant: 3.2×10^{-5} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Possible dechlorination of C=C double bond
oxidation: Probably not important
hydrolysis: Very slow
volatilization: Not important
sorption: Occurs to a moderate degree
biological processes: Biotransformation occurs very slowly, but could be important
other reactions/interactions: Unknown

Carbon Adsorption Data [4]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 9 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF HEPTACHLOR EPOXIDE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	BDL	BDL	BDL
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.2	0.07	0	NA	0.0037

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF HEPTACHLOR EPOXIDE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	<6.7	<0.6	0	0.016	0.0023
Foundries	<5	<5	<5	0	0.034	0.014
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.7	0.1	0	NA	0.0053

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR HEPTACHLOR EPOXIDE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Sedimentation with chemical addition (alum, lime)			>29[d]	<1[d]	III.4.3
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	~100	0.4			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

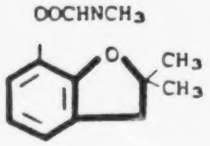
1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 30-1 - 30-9.

2. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 547.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Carbofuran **Formula:**



Alternate Names: [1] 2,3-Dihydro-2,2-dimethyl-7-benzofuranol methylcarbamate, Methyl carbamic acid, 2,3-Dihydro-2,2-dimethyl-7-benzofuranyl ester

CAS #: 156-36-62

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 221.3 m.p., °C: 150-153 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: 2×10^{-5}
solubility in water (25°C), mg/L: 700
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF CARBOFURAN[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF CARBOFURAN[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CARBOFURAN[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

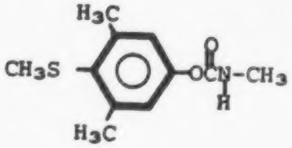
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976. pp. 1808, 1809.

2. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 155.

Compound: Mercaptodimethur **Formula:**



Alternate Names: Methiocarb, Mesurol

CAS #: 2032-65-7

Physical, Chemical, and Biological Properties [1]

mol. wt.: 225.3 m.p., °C: 117-118 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: Negligible
solubility in water (25°C), mg/L: Insoluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

Date: 6/23/80

INDUSTRIAL OCCURRENCE OF MERCAPTODIMETHUR[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF MERCAPTODIMETHUR[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR MERCAPTODIMETHUR[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part II, pp. 54, 55.

Compound: Chlordane **Formula:**

Alternate Names: 1,2,4,5,6,7,8,8-Octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane

CAS #: 57-74-9

Physical, Chemical, and Biological Properties [1-3]

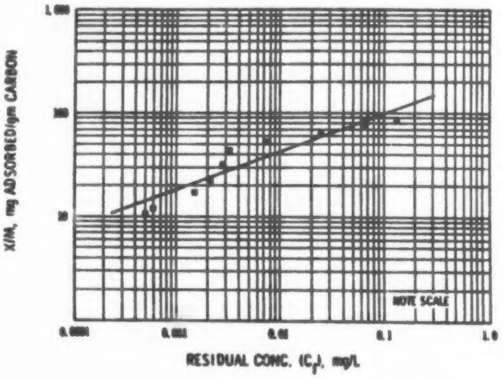
mol. wt.: 409.8 m.p., °C: 107-109(*cis*) b.p. (2 torr), °C: 175
vapor pressure (25°C), torr: 1×10^{-5}
solubility in water (25°C), mg/L: 1.85
log octanol/water partition coefficient: 2.78
Henry's law constant: 4.8×10^{-5} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Sensitized processes may be important
oxidation: No information available
hydrolysis: Not important
volatilization: Probably an important process
sorption: Probably an important process
biological processes: Bioaccumulation is an important process
other reactions/interactions: Not important

Carbon Adsorption Data [4]

pH: 5.3
type of carbon: Filtrasorb-300
adsorbability: 37 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.3



INDUSTRIAL OCCURRENCE OF CHLORDANE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Auto and other laundries	ND	≤3.0	NA	$<1.4 \times 10^{-6}$	<0.0021	<0.00032
Foundries	ND	NA	12	0	0.08	0.032
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	1.2	0.15	NA	NA	NA
Timber products processing	<0.001	0.035	NA	0	0.00078	1×10^{-6}

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF CHLORDANE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Timber products processing	NA	NA	NA	NA	NA	NA
Foundries	<5	24	8	0	0.054	0.022
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	31	1.1	0	NA	0.058

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CHLORDANE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	
Gravity oil separation			NA	3[d]	III.4.1
Filtration			37[d]	24[d]	III.4.6
Activated sludge	0	NA			III.5.1
Powdered activated carbon adsorption	~100	0.5			III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 22-1 - 22-13.

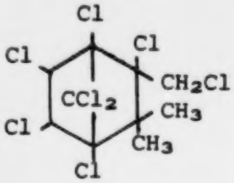
2. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 159.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Toxaphene

Formula:



Alternate Names: Polychlorocamphene

CAS #: 8001-35-2

Physical, Chemical, and Biological Properties [1-4]

mol. wt.: 414 m.p., °C: 70-90 b.p. (760 torr), °C: Decomposes >120
vapor pressure (25°C), torr: 0.2-0.4
solubility in water (25°C), mg/L: 1.75
log octanol/water partition coefficient: 3.3±0.4
Henry's law constant: 4.89×10^{-3} atmos. m^3 $mole^{-1}$
biodegradability: Not available

Probable Fate [1]

photolysis: Not an important process
oxidation: Probably not an important process
hydrolysis: Too slow to be important
volatilization: May be an important process
sorption: Is an important process
biological processes: Bioaccumulation is an important process; biodegraded in anaerobic systems, but not in aerobic systems
other reactions/interactions: Unknown

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF TOXAPHENE[a]

Industry	Raw wastewater Concentration, µg/L Minimum	 Maximum	 Mean	 Loading,[c] kg/d Minimum	 Maximum	 Mean
Iron and steel manufacturing	NA	NA	<10	0	NA	<1.8
Nonferrous metals manufacturing	ND	0.4	0.25	0	NA	<0.013

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF TOXAPHENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Iron and steel manufacturing	NA	NA	2	0	NA	0.36

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR TOXAPHENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Gravity oil separation			NA	3[d]	III.4.1

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 35-1 - 35-13.

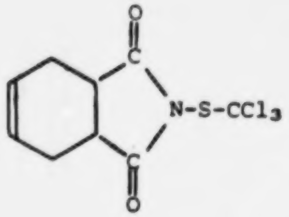
2. Guyer, G. E., et al. Toxaphene Status Report. U.S. Environmental Protection Agency, Washington, D.C., 1971. p. 10.

3. Warner, H. P., J. M. Cohen, and J. C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio. April, 1980. 14 pp.

4. Ferguson, T. L., F. J. Bergman, G. R. Cooper, R. T. Li, and F. I. Honea Determination of Incinerator Operating Conditions Necessary for Safe Disposal of Pesticides. Contract 68-03-0286. U.S. Environmental Protection Agency, Cincinnati, Ohio. July, 1975. p. 225.

Compound: Captan

Formula:



Alternate Names: N(trichloromethylthio-4-cyclohexene-1,2,-dicarboxylic acid,imide

CAS #: 133-06-2

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 300.6 m.p., °C: 158-164 b.p. (760 torr), °C: Decomposes near melting point

vapor pressure (25°C), torr: 6×10^{-5}
solubility in water (25°C), mg/L: <0.5
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF CAPTAN[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF CAPTAN[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CAPTAN[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

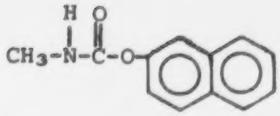
REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part II, pp. 46, 47.

2. Ferguson, T. L., F. J. Bergman, G. R. Cooper, R. T. Li, and F. I. Honea, Determination of Incinerator Operating Conditions Necessary for Safe Disposal of Pesticides. Contract 68-03-0286. U.S. Environmental Protection Agency, Cincinnati, Ohio. July, 1975. p. 280.

Compound: Carbaryl

Formula:



Alternate Names: 1-Naphthyl methylcarbamate; Methylcarbamic acid, 1-naphthyl ester; Sevin

CAS #: 63-25-2

Physical, Chemical, and Biological Properties [1]

mol. wt.: 201.2 m.p., °C: 142 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: <0.005
solubility in water (30°C), mg/L: 40
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF CARBARYL[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF CARBARYL[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CARBARYL[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal[c] range, %	Average achievable conc., μg/L	Removal[c] range, %	Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

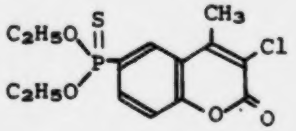
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part II, pp. 36, 37.

Compound: Coumaphos

Formula:



Alternate Names: 0-(3-Chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl),0,0-diethyl phosphorothioate, Co-Ral

CAS #: 56-72-4

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 362.8 m.p., °C: 90-92 b.p. (760 torr), °C: Not available
vapor pressure (20°C), torr: 1×10^{-7}
solubility in water (25°C), mg/L: 1.5
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF COUMAPHOS[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF COUMAPHOS[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR COUMAPHOS[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

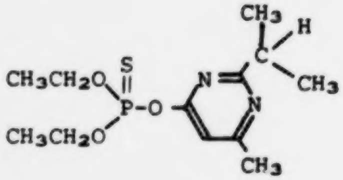
REFERENCES

1. Meister Publishing Co. 1976 Farm Chemicals Handbook. Willoughby, Ohio, 1976. p. D 67.

2. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 167.

Compound: Diazinon

Formula:



Alternate Names: 0,0-Diethyl-0-(2-isopropyl-6-methyl-4-pyrimidinyl)ester

CAS #: 333-41-5

Physical, Chemical, and Biological Properties [1]

mol. wt.: 304.4   m.p., °C: Not available   b.p. (2×10^{-3} torr), °C: 83-84
vapor pressure (20°C), torr: 1.4×10^{-4}
solubility in water (20°C), mg/L: 40
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF DIAZINON[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF DIAZINON[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DIAZINON[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

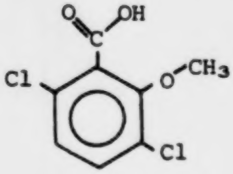
Note: No data available. Data will be supplied in future revisions

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 83-85.

Compound: Dicamba

Formula:



Alternate Names: Banvel,3,6-Dichloro-*o*-anisic acid

CAS #: 1918-00-9

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 221.0 m.p., °C: 114-116 b.p. (760 torr), °C: Not available
vapor pressure (100°C), torr: 3.75×10^{-3}
solubility in water (25°C), mg/L: 4,500
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF DICAMBA[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions

INDUSTRIAL OCCURRENCE OF DICAMBA[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DICAMBA[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

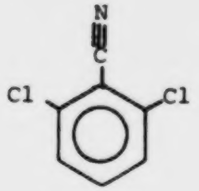
1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 189.

2. Meister Publishing Co. 1976 Farm Chemicals Handbook. Willoughby, Ohio, 1976. p. D 28.

3. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 138.

Compound: Dichlobenil

Formula:



Alternate Names: Casoron 113, 2,6-Dichlorobenzonitrile

CAS #: 1194-65-6

Physical, Chemical, and Biological Properties [1]

mol. wt.: 172 m.p., °C: 139-145 b.p. (760 torr), °C: 270
vapor pressure (20°C), torr: 5.5×10^{-4}
solubility in water (20°C), mg/L: 25
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF DICHLOBENIL[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF DICHLOBENIL[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DICHLOBENIL[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

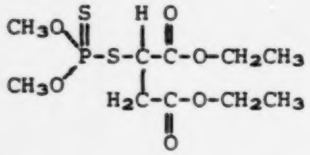
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 178.

Compound: Malathion

Formula:



Alternate Names: Diethyl mercaptosuccinate, s-ester with 0,0-dimethyl phosphorodithioate

CAS #: 121-75-5

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 330   m.p., °C: 2.85   b.p. (0.7 torr), °C: 156-156 (slight decomposition)

vapor pressure (20°C), torr: 4×10^{-5}
solubility in water, mg/L: 145
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF MALATHION[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF MALATHION[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR MALATHION[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

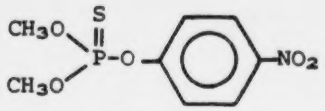
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Meister Publishing Co. 1976 Farm Chemicals Handbook. Willoughby, Ohio, 1976. pp. D 153 - D 154.

2. Ferguson, T. L., F. J. Bergman, G. R. Cooper, R. T. Li, and F. I. Honea, Determination of Incinerator Operating Conditions Necessary for Safe Disposal of Pesticides. Contract 68-03-0286. U.S. Environmental Protection Agency, Cincinnati, Ohio. July, 1975. p. 200.

Compound: Methyl parathion **Formula:**



Alternate Names: 0,0-Dimethyl-0-*p*-nitrophenyl phosphorothioate

CAS #: 298-00-0

Physical, Chemical, and Biological Properties [1, 2]

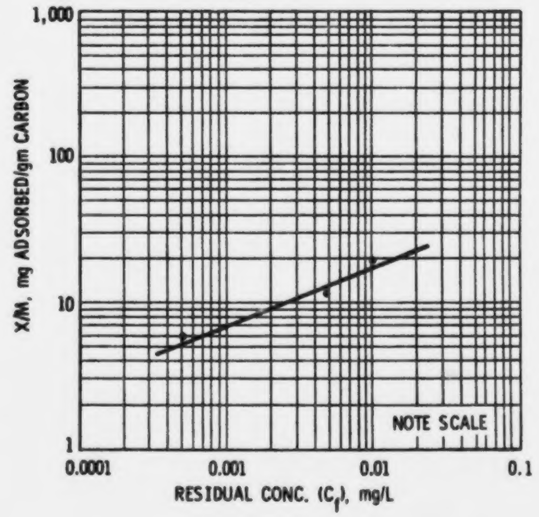
mol. wt.: 263.2 m.p., °C: 35-36 b.p. (760 torr), °C: Thermally unstable
vapor pressure (20°C), torr: 0.97×10^{-5}
solubility in water (25°C), mg/L: 55-60
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data [3]

pH: Not available
type of carbon: Filtrasorb-300
adsorbability: Not available



INDUSTRIAL OCCURRENCE OF METHYL PARATHION[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF METHYL PARATHION[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR METHYL PARATHION[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

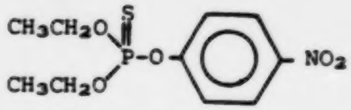
REFERENCES

1. Initial Scientific and Minieconimic Review of Methyl Parathion, Criteria and Evaluation Division, Office of Pesticide Programs, U.S. Environmental Progection Agency, Washington, D.C., February 1975. pp. 14, 17.

2. Meister Publishing Co. 1976 Farm Chemicals Handbook. Willoughby, Ohio, 1976. p. D 166.

3. Report on visit of D. Stephan and W. Cawley, U.S. Environmental Protection Agency, to Calgon Environmental Systems Division, Calgon Corporation, Pittsburgh, Pennsylvania, 9 April 1979. 132 pp.

Compound: Parathion **Formula:**



Alternate Names: 0,0-Diethyl-0-*p*-nitrophenyl phosphorothioate

CAS #: 56-38-2

Physical, Chemical, and Biological Properties [1, 2]

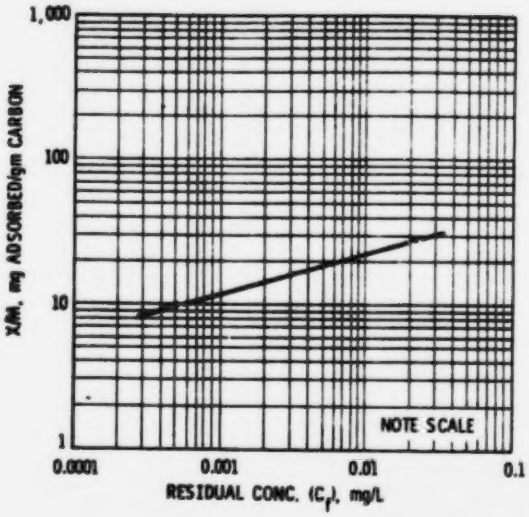
mol. wt.: 291.3 m.p., °C: 6.1 b.p. (760 torr), °C: 375
vapor pressure (20°C), torr: 3.78×10^{-5}
solubility in water (25°C), mg/L: 24
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data [2]

pH: Not available
type of carbon: Filtrasorb-300
adsorbability: Not available



INDUSTRIAL OCCURRENCE OF PARATHION[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF PARATHION[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR PARATHION[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

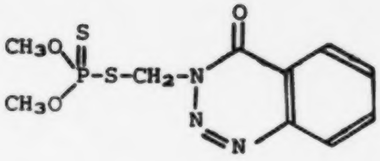
REFERENCES

1. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-411.

2. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 240.

Compound: Guthion

Formula:



Alternate Names: Azinphos-methyl, Benzotriazinedithiophosphoric acid dimethoxy ester

CAS #: 86-50-0

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 317.3 m.p., °C: 73-74 b.p. (760 torr), °C: Decomposes at 200
vapor pressure (20°C), torr: $<3.8 \times 10^{-4}$
solubility in water (25°C), mg/L: 33
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF GUTHION[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF GUTHION[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR GUTHION[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

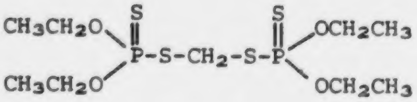
REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 20-22.

2. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 203.

Compound: Ethion

Formula:



Alternate Names: O,O,O',O'-Tetraethyl-S,S'-methylene-bisphosphorodithioate

CAS #: 563-12-2

Physical, Chemical, and Biological Properties [1]

mol. wt.: 384.5 m.p., °C: -12 to -13 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: 1.5×10^{-6}
solubility in water: Slightly soluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF ETHION[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ETHION[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ETHION[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

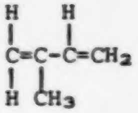
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 63-66.

Compound: Isoprene

Formula:



$$\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}=\underset{\underset{CH_3}{|}}{C}-\overset{\overset{H}{|}}{C}=CH_2$$

Alternate Names: 2-Methyl-1,3-butadiene

CAS #: 78-79-5

Physical, Chemical, and Biological Properties [1]

mol. wt.: 68.13 m.p., °C: ∿-120 b.p. (760 torr), °C: 34.1
vapor pressure (15.4°C), torr: 400
solubility in water (25°C), mg/L: Almost totally insoluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF ISOPRENE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ISOPRENE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ISOPRENE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

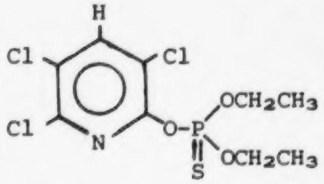
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 59, 60.

Compound: Chlorpyrifos

Formula:



Alternate Names: Dursban, O,O-Diethyl-O-(3,5,6-trichloro-2-pyridyl)-phosphorothioate, Lorsban, Dowco 179

CAS #: 2921-88-2

Physical, Chemical, and Biological Properties [1]

mol. wt.: 350.6 m.p., °C: 41-42 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: 1.8×10^{-5}[2]
solubility in water (35°C), mg/L: 2
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF CHLORPYRIFOS[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF CHLORPYRIFOS[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CHLORPYRIFOS[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

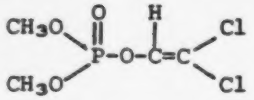
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 74-76.

Compound: Dichlorvos

Formula:



Alternate Names: 2,2-Dichlorovinyl-
O,O-dimethyl phosphate

CAS #: 62-73-7

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 221 m.p., °C: Not available b.p. (20 torr), °C: 140
vapor pressure (20°C), torr: 1.2×10^{-2}
solubility in water (20°C), mg/L: 10,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF DICHLORVOS[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF DICHLORVOS[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DICHLORVOS[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

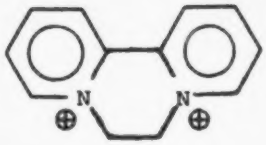
REFERENCES

1. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 178.

2. Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976.

Compound: Diquat

Formula:



Alternate Names: Usually exists as Diquat dibromide

CAS #: 85-00-7 (Diquat dibromide)

Physical, Chemical, and Biological Properties of Diquat dibromide [1]

mol. wt.: 344.1 m.p., °C: 335-340 b.p. (760 torr), °C: Decomposes 335-340
vapor pressure (25°C), torr: Not available
solubility in water (20°C), mg/L: 700,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF DIQUAT[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF DIQUAT[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DIQUAT[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

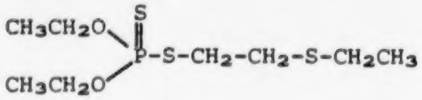
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 118, 119.

Compound: Disulfoton

Formula:



Alternate Names: O,O-Diethyl S-[2-ethylthio)ethyl] phosphorodithioate

CAS #: 298-04-4

Physical, Chemical, and Biological Properties [1]

mol. wt.: 274.4 m.p., °C: >-25 b.p. (1.5 torr), °C: 132-133
vapor pressure (20°C), torr: 1.8×10^{-4}
solubility in water (23°C), mg/L: 25
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate : Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF DISULFOTON[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF DISULFOTON[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DISULFOTON[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

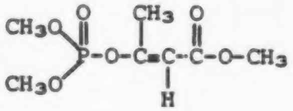
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 135-137.

Compound: Mevinphos

Formula:



$(CH_3O)_2P(=O)-O-C(CH_3)=CH-C(=O)-O-CH_3$

Alternate Names: Phosdrin, 2-Methoxycarbonyl-1-methylvinyl dimethyl phosphate

CAS #: 7786-34-7

Physical, Chemical, and Biological Properties [1]

mol. wt.: 224.2 m.p., °C: Not available b.p. (1 torr), °C: 106-108
vapor pressure (21°C), torr: 2.9×10^{-3}
solubility in water (25°C), mg/L: Miscible
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF MEVINPHOS[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF MEVINPHOS[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR MEVINPHOS[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

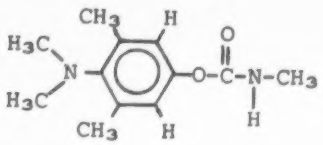
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 43-45.

Compound: Mexacarbate

Formula:



Alternate Names: Zectran, 4-Dimethylamino-3,5-xylyl N-methylcarbamate

CAS #: 315-18-4

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 222.3 m.p., °C: 85 b.p. (760 torr), °C: Not available
vapor pressure (139°C), torr: <0.1
solubility in water (25°C), mg/L: 100
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate : Not available]

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF MEXACARBATE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF MEXACARBATE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR MEXACARBATE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

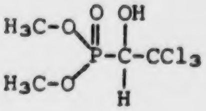
REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 29, 30.

2. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 304.

Compound: Trichlorfon

Formula:



Alternate Names: Dylox, Dimethyl(2,2,2-trichloro-1-hydroxyethyl) phosphonate

CAS #: 52-68-6

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 257 m.p., °C: 81-82 b.p. (0.1 torr), °C: 100
vapor pressure (25°C), torr: 7.8×10^{-6}
solubility in water (25°C), mg/L: 154,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF TRICHLORFON[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF TRICHLORFON[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR TRICHLORFON[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

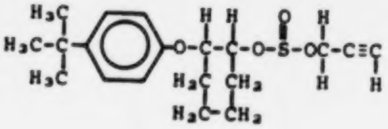
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Meister Publishing Co. 1976 Farm Chemicals Handbook. Willoughby, Ohio, 1976. p. D 103.

2. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 188.

Compound: Propargite Formula:



Alternate Names: Omite, 2-(*p-tert*-Butylphenoxy) cyclohexyl-2-proponyl sulfite

CAS #: 2312-35-8

Physical, Chemical, and Biological Properties [1]

mol. wt.: 350 m.p., °C: Not available b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Insoluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF PROPARGITE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF PROPARGITE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR PROPARGITE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal[c] range, %	Average achievable conc., µg/L	Removal[c] range, %	Average achievable conc., µg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Ouellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977. p. 242.

Compound: Carbon disulfide Formula: S=C=S

Alternate Names: Dithiocarbonic anhydride

CAS #: 75-15-0

Physical, Chemical, and Biological Properties [1]

mol. wt.: 76.14 m.p., °C: -111 b.p. (760 torr), °C: 46.3
vapor pressure (25°C), torr: 360
solubility in water (20°C), mg/L: 2,940
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF CARBON DISULFIDE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF CARBON DISULFIDE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CARBON DISULFIDE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

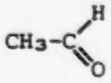
[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 109, 110.

Compound: Acetaldehyde Formula:



$CH_3-CH=O$

Alternate Names: Ethanal, Ethyl aldehyde

CAS #: 75-07-0

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 44.05 m.p., °C: -124 b.p. (760 torr), °C: 21
vapor pressure (20°C), torr: 740
solubility in water (25°C), mg/L: Miscible
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 93% acetaldehyde removal (measured as BOD) obtained in 5-day static activated sludge test

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF ACETALDEHYDE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ACETALDEHYDE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ACETALDEHYDE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Anaerobic lagoons			58-67	28	III.5.3

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

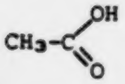
[c] Average and maximum removals reported.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 145-147.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. pp. 57-59.

Compound: Acetic acid **Formula:**



$CH_3-C(=O)OH$

Alternate Names: Ethanoic acid, Methane carboxylic acid, Vinegar acid

CAS #: 64-19-7

Physical, Chemical, and Biological Properties [1]

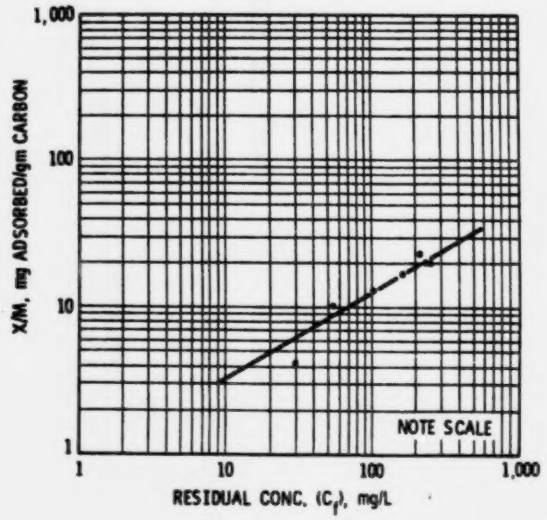
mol. wt.: 60.05 m.p., °C: 16.7 b.p. (760 torr), °C: 118
vapor pressure (20°C), torr: 11.4
solubility in water (20°C), mg/L: Miscible
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 50% theoretical oxidation of 500 ppm acetic acid by phenol acclimated sludge after 12 hr aeration

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data [2]

pH: 4.0
type of carbon: Filtrasorb-300
adsorbability: Not available



Date: 6/23/80

INDUSTRIAL OCCURRENCE OF ACETIC ACID[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ACETIC ACID[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ACETIC ACID[a,b]

Treatment process[a]	Synthetic wastewater: Removal[c] range, %	Synthetic wastewater: Average achievable conc., µg/L	Actual wastewater: Removal[c] range, %	Actual wastewater: Average achievable conc., µg/L	Volume III references, Section numbers
Anaerobic lagoons			0[d]	-[d]	III.5.3

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Actual data indicate negative removal.

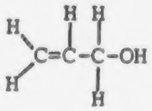
REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 74.

2. Report on visit of D. Stephan and W. Cawley, U.S. Environmental Protection Agency, to Calgon Environmental Systems Division, Calgon Corporation, Pittsburgh, Pennsylvania, 9 April 1979. 132 pp.

Compound: Allyl alcohol

Formula:



Alternate Names: 2-Propen-1-ol

CAS #: 107-18-6

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 58.08   m.p., °C: -50   b.p. (760 torr), °C: 96-97
vapor pressure (25°C), torr: 23.8
solubility in water, mg/L: Miscible
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 57% allyl alcohol removal (measured in BOD removal) obtained in 10-day static activated sludge test for initial allyl alcohol concentrations of 1,000 mg/L

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF ALLYL ALCOHOL[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ALLYL ALCOHOL[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ALLYL ALCOHOL[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

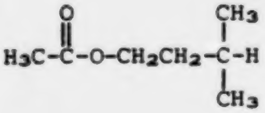
REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 94, 95.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. pp. 83-85.

Compound: Amyl acetate

Formula:



$H_3C-\overset{\overset{O}{\|}}{C}-O-CH_2CH_2-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-H$

Alternate Names: Isoamyl acetate, Acetic acid 3-methylbutyl ester

CAS #: 123-92-2

Physical, Chemical, and Biological Properties [1]

mol. wt.: 130.1 m.p., °C: -78.5 b.p. (760 torr), °C: 142
vapor pressure (25°C), torr: 6
solubility in water (25°C), mg/L: 2,500
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF AMYL ACETATE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF AMYL ACETATE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR AMYL ACETATE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

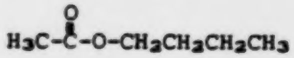
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 1, 2.

Compound: n-Butyl acetate

Formula:



$H_3C-\overset{O}{\overset{\|}{C}}-O-CH_2CH_2CH_2CH_3$

Alternate Names: Acetic acid butyl ester; Butyl ethanoate

CAS #: 123-86-4

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 116.2 m.p., °C: -77.9 b.p. (760 torr), °C: 125-126
vapor pressure (25°C), torr: 15
solubility in water (25°C), mg/L: 8,300
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 7% of theoretical oxygen demand removed in 5-day BOD test

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF BUTYL ACETATE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF BUTYL ACETATE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BUTYL ACETATE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

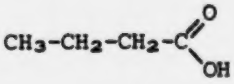
1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 164, 165.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. pp. 141-143.

3. Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976.

Compound: Butyric acid

Formula:



$CH_3-CH_2-CH_2-C(=O)OH$

Alternate Names: Butanoic acid, Ethylacetic acid, Propylformic acid

CAS #: 107-92-6

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 88.12 m.p., °C: -7.9 b.p. (760 torr), °C: 164
vapor pressure (20°C), torr: 0.84
solubility in water (25°C), mg/L: Miscible
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 25% of theoretical oxygen demand removed in 12 hr static activated sludge test

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF BUTYRIC ACID[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF BUTYRIC ACID[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR BUTYRIC ACID[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers
Anaerobic lagoons			0[d]	-[d]	III.5.3

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Actual data indicate negative removal.

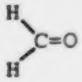
REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, p. 39.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 158.

Compound: Formaldehyde

Formula:



Alternate Names: Methanal, Formalin, Oxomethane

CAS #: 50-00-0

Physical, Chemical, and Biological Properties [1]

mol. wt.: 30.0 m.p., °C: -118 to -92 b.p. (760 torr), °C: -21 to -19

vapor pressure (-88°C), torr: 10

solubility in water (25°C), mg/L: Not available

log octanol/water partition coefficient: Not available

Henry's law constant: Not available

biodegradability: 60% of theoretical oxygen demand removed in 5-day BOD test

Probable Fate: Not available

photolysis:

oxidation:

hydrolysis:

volatilization:

sorption:

biological processes:

other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF FORMALDEHYDE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF FORMALDEHYDE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR FORMALDEHYDE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

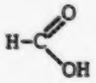
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 342.

Compound: Formic acid

Formula:



Alternate Names: Methanoic acid, Hydrogen carboxylic acid, Formylic acid

CAS #: 64-18-6

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 46.03 m.p., °C: 8.4 b.p. (760 torr), °C: 101
vapor pressure (24°C), torr: 40
solubility in water (25°C), mg/L: Miscible
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 70% of theoretical oxygen demand removed in 24 hr static activated sludge test

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF FORMIC ACID[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF FORMIC ACID[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR FORMIC ACID[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

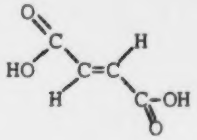
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 11-13.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 346.

Compound: Fumaric acid **Formula:**



Alternate Names: *Trans*-1,2-ethylenedicarboxylic acid, *Trans*-butenedioic acid, Allomaleic acid

CAS #: 110-17-8

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 116.1 m.p., °C: 300 to 302 (sealed tube)
b.p. (1.7 torr), °C: Sublimes at 165
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: 7,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 1.7% of theoretical oxygen demand removed after 24 hr static activated sludge test

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF FUMARIC ACID[a,b]

	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF FUMARIC ACID[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR FUMARIC ACID[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

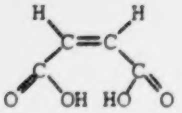
REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, p. 52.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977.

Compound: Maleic acid

Formula:



Alternate Names: *Cis*-1,2-ethylenedicarboxylic acid, Toxilic acid, *Cis*-butenedioic acid

CAS #: 110-16-7

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 116.1 m.p., °C: 130.5 b.p. (760 torr), °C: Decomposes at 135
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Freely soluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 4.5% of theoretical oxygen demand removed after 12 hr static activated sludge test

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF MALEIC ACID[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF MALEIC ACID[a,b]

	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR MALEIC ACID[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

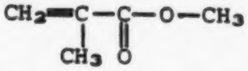
REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 56, 57.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 420.

Compound: Methyl methacrylate

Formula:



$CH_2{=}C(CH_3){-}C({=}O){-}O{-}CH_3$

Alternate Names: 2-Methyl-propenoic acid, methyl ester

CAS #: 80-62-6

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 100.1 m.p., °C: -48 b.p. (760 torr), °C: 100-101
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Slightly soluble
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 47% theoretical oxidation of 10 mg/L methyl methacrylate observed in 10-day static activated sludge test

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF METHYL METHACRYLATE[a,b]

	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF METHYL METHACRYLATE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR METHYL METHACRYLATE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

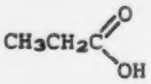
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-465.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 464.

Compound: Propionic acid **Formula:**



$CH_3CH_2C(=O)OH$

Alternate Names: Propanoic acid,
Methylacetic acid

CAS #: 79-09-4

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 74.08 m.p., °C: -20.8 b.p. (760 torr), °C: 141
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Miscible
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 40% of theoretical oxygen demand removed after 24 hr static activated sludge test

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF PROPIONIC ACID[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF PROPIONIC ACID[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR PROPIONIC ACID[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	
Anaerobic lagoons			0[d]	-[d]	III.5.3

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Actual data indicate negative removal.

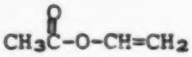
REFERENCES

1. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-451.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 548.

Compound: Vinyl acetate

Formula:



$CH_3C(=O)-O-CH=CH_2$

Alternate Names: Acetic acid, ethenyl ester;
1-Acetoxyethylene

CAS #: 108-05-4

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 86.10 m.p., °C: -93.2 b.p. (760 torr), °C: 72.2-72.3
vapor pressure (21°C), torr: 100
solubility in water (20°C), mg/L: 20,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 42% theoretical oxidation of 10 mg/L vinyl acetate observed in 10-day static activated sludge test

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF VINYL ACETATE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF VINYL ACETATE[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR VINYL ACETATE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

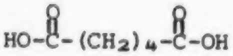
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 158, 159.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 634.

Compound: Adipic acid

Formula: 

$HO-\overset{O}{\overset{\|}{C}}-(CH_2)_4-\overset{O}{\overset{\|}{C}}-OH$

Alternate Names: 1,6-Hexanedioic acid,
1,4-Butanedicarboxylic
acid

CAS #: 124-04-9

Physical, Chemical, and Biological Properties [1]

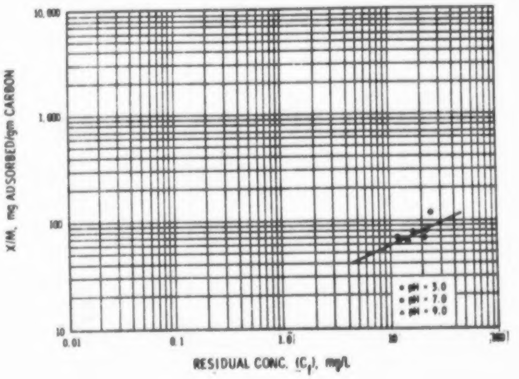
mol. wt.: 146.1 m.p., °C: 153 b.p. (760 torr), °C: 338
vapor pressure (159°C), torr: 1
solubility in water (25°C), mg/L: 14,400
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data [2]

pH: 3.0, 7.0, 9.0
type of carbon: Not available
adsorbability: 450 ng/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at neutral pH



INDUSTRIAL OCCURRENCE OF ADIPIC ACID[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ADIPIC ACID[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ADIPIC ACID[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

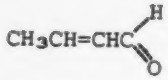
REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 104, 105.

2. Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Compound: Crotonaldehyde

Formula:



$CH_3CH{=}CHC\overset{H}{\underset{O}{}}$

Alternate Names: 2-Butenal

CAS #: 123-73-9

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 70.09 m.p., °C: -74 b.p. (760 torr), °C: 104-105
vapor pressure (25°C), torr: Not available
solubility in water (20°C), mg/L: 180,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 37% of theoretical oxygen demand removed in 5-day BOD test

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF CROTONALDEHYDE[a,b]

	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF CROTONALDEHYDE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CROTONALDEHYDE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

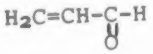
1. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-229.

2. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 201.

3. Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976.

Compound: Acrolein

Formula:



$H_2C{=}CH{-}\overset{\displaystyle O}{\overset{\|}{C}}{-}H$

Alternate Names: Aqualin, Acrylaldehyde,
2-Propenal, Allylaldehyde

CAS #: 107-02-8

Physical, Chemical, and Biological Properties [1, 2]

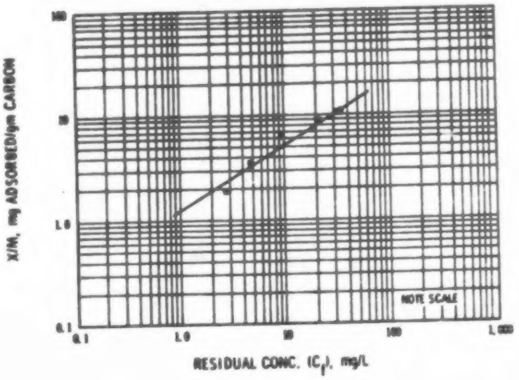
mol. wt.: 56.1 m.p., °C: -87.7 b.p. (760 torr), °C: 52.5
vapor pressure (20°C), torr: 220
solubility in water (temp. unknown), mg/L: 400,000
log octanol/water partition coefficient: -0.090
Henry's law constant: Not available
biodegradability: Not available

Probable Fate:

photolysis: Probable photooxidation in atmosphere
oxidation: Can occur slowly
hydrolysis: Not an important process
volatilization: Principal transport mechanism
sorption: Not an important process
biological processes: Biotransformation occurs readily; biodegradation not important
other reactions/interactions: Unknown

Carbon Adsorption Data [3]

pH: 5.2
Type of carbon: Filtrasorb-300
Absorbability: 7,500 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.2



INDUSTRIAL OCCURRENCE OF ACROLEIN[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ACROLEIN[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ACROLEIN[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers
Gas flotation with chemical addition (alum, polymer)			0[d,e]	-[e]	III.4.5
Filtration			>86[d]	<100[d]	III.4.6
Powdered activated carbon adsorption	93	2,700	30[d]	700,000[d]	III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

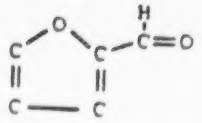
[e] Actual data indicate negative removal.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 74.
2. McGraw Hill, Inc. Lange's Handbook of Chemistry, 12th Edition. New York, New York, 1979. pp. 7-64.

Compound: Furfural

Formula:



Alternate Names: Furfurole, 2-Furancarbonyl, 2-Furaldehyde, Fural, Furfuraldehyde, Furole

CAS #: 98-01-1

Physical, Chemical, and Biological Properties [1-4]

mol. wt.: 96.09 m.p., °C: -38.7 b.p. (760 torr), °C: 162
vapor pressure (25°C), torr: ∿1.65
solubility in water (temp. unknown), mg/L: 91,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 96% furfural removal (measured as COD removal) obtained at 20°C in activated sludge at a rate of 37 mg COD/g dry innoculum/hr

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF FURFURAL[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF FURFURAL[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR FURFURAL[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

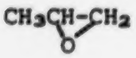
1. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-314.

2. Jordan, T. E. Vapor Pressure of Organic Compounds. Interscience Publishers, Inc. New York, New York, 1954. p. 104.

3. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

4. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 349.

Compound: Propylene oxide **Formula:**



$CH_3CH\text{-}CH_2$ with O bridging CH and CH_2

Alternate Names: 1,2-Epoxy-propane, Methyloxiron

CAS #: 75-56-9

Physical, Chemical, and Biological Properties [1-3]

mol. wt.: 58.08 m.p., °C: -104 b.p. (760 torr), °C: 34.3
vapor pressure (25°C), torr: ~530
solubility in water, mg/L: 650,000 at 30°C; 405,000 at 20°C
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 75% propylene oxide removal (measured as BOD removal) obtained in 5-day static activated sludge test on a 333 mg/L solution

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF PROPYLENE OXIDE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF PROPYLENE OXIDE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR PROPYLENE OXIDE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 544.

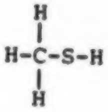
2. CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977. p. C-448.

3. Jordan, T. E. Vapor Pressure of Organic Compounds. Interscience Publishers, Inc. New York, New York, 1954. p. 118, plate 2.

4. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 544.

Compound: Methyl mercaptan

Formula:



$$H-\overset{H}{\underset{H}{C}}-S-H$$

Alternate Names: Methanethiol, Mercaptomethane, Methyl sulfhydrate, Thiomethyl alcohol

CAS #: 74-93-1

Physical, Chemical, and Biological Properties [1]

mol. wt.: 48.10 m.p., °C: -123 b.p. (760 torr), °C: 5.95
vapor pressure (25°C), torr: Not available
solubility in water (20°C), mg/L: 23,330
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF METHYL MERCAPTAN[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF METHYL MERCAPTAN[a,b]

Industry	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR METHYL MERCAPTAN[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

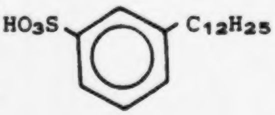
[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979. Part III, pp. 130, 131.

Compound: Dodecyl benzenesulfonic acid Formula:



Alternate Names: Benzenesulfonic acid, dodecyl ester; Dodecylbenzenesulfonate

CAS #: 1886-81-3

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 326.5 m.p., °C: Not available b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: Not available
solubility in water (25°C), mg/L: Not available
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: 99% removal (measured as COD removal) obtained at 20°C in activated sludge as a rate of 11 mg COD/g dry innoculum/hr

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF DODECYL BENZENE SULFONIC ACID[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF DODECYL BENZENE SULFONIC ACID[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR DODECYLBENZENE SULFONIC ACID[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

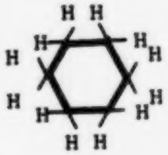
REFERENCES

1. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 165.

2. Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

Compound: Cyclohexane

Formula:



Alternate Names: Hexahydrobenzene,
Hexamethylene,
Hexanaphthene

CAS #: 110-82-7

Physical, Chemical, and Biological Properties [1]

mol. wt.: 84.16 m.p., °C: 6.3 b.p. (760 torr), °C: 81
vapor pressure (20°C), torr: 77
solubility in water (20°C), mg/L: 55
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

INDUSTRIAL OCCURRENCE OF CYCLOHEXANE[a,b]

Industry	Raw wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF CYCLOHEXANE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR CYCLOHEXANE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

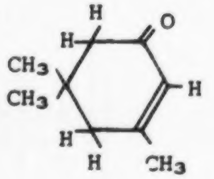
Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 204.

Compound: Isophorone

Formula:



Alternate Names: Trimethylcyclohexenone, Isooctaphenone, 3,5,5-Trimethyl-2-cyclohexene-1-one

CAS #: 78-59-1

Physical, Chemical, and Biological Properties [1]

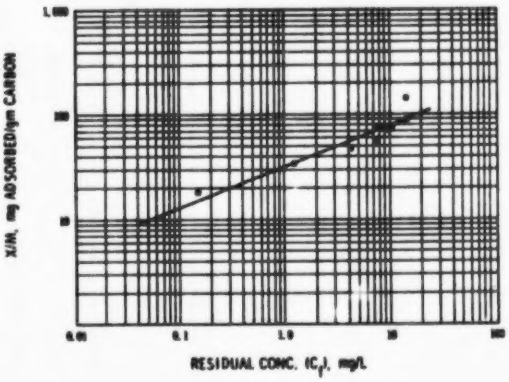
mol. wt.: 138.2 m.p., °C: -8 b.p. (760 torr), °C: 215
vapor pressure (20°C), torr: 0.38
solubility in water (temp. unknown), mg/L: 12,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data [2]

pH: 5.5
type of carbon: Filtrasorb-300
adsorbability: 280 mg/L; carbon dose required to reduce pollutant concentration from 10 mg/L to 1 mg/L at a pH of 5.5



INDUSTRIAL OCCURRENCE OF ISOPHORONE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	ND	307	44	0	1.2	0.17
Paint and ink formulation	ND	44,000[d]	NA	0	1.0	0.035
Rubber processing	NA	NA	NA	NA	NA	NA
Auto and other laundries	ND	190	10	9.0×10^{-6}	0.014	0.0021
Coil coating	ND	600	300	0.015	0.54	0.14
Iron and steel manufacturing	NA	NA	4,000	0	NA	720
Nonferrous metals manufacturing	ND	29	1.6	0	NA	0.085

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

INDUSTRIAL OCCURRENCE OF ISOPHORONE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Coal mining	NA	ND	ND	-[d]	-[d]	-[d]
Paint and ink formulation	ND	200	78	0	0.0036	0.00012
Rubber processing	NA	<7[e]	<7[e]	1.4×10^{-6}	0.0062	0.00023
Auto and other laundries	ND[e]	ND[e]	ND[e]	-[d]	-[d]	-[d]
Pharmaceutical manufacturing	ND	ND	ND	-[d]	-[d]	-[d]
Foundries	<20	<20	<20	0	<0.13	<0.054
Iron and steel manufacturing	NA	NA	95	0	NA	17
Nonferrous metals manufacturing	ND	6	3	0	NA	0.16

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

[d] Mean pollutant concentration below detection limit.

[e] One sample.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ISOPHORONE[a,b]

Treatment process[a]	Synthetic wastewater Removal range,[c] %	Synthetic wastewater Average achievable conc., μg/L	Actual wastewater Removal range,[c] %	Actual wastewater Average achievable conc., μg/L	Volume III references, Section numbers
Gravity oil separation			NA	6[d]	III.4.1
Gas flotation with chemical addition (calcium chloride, polymer)			>95[d]	ND	III.4.5
Sedimentation			49->97	<23	III.4.2
Aerated lagoons			33[d]	2[d]	III.5.3
Activated sludge	~100	<50	0[d,e]	-[e]	III.5.1
Powdered activated carbon adsorption	99	160	97[d]	30,000[d]	III.6.2

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

[d] Only one data point.

[e] Actual data indicate negative removal.

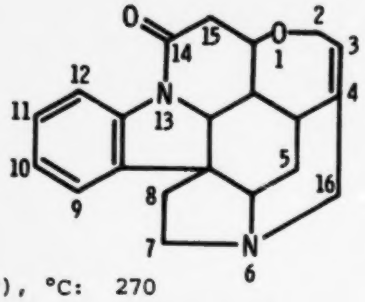
REFERENCES

1. Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977. p. 404.

2. Dobbs, R. A., and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April, 1980.

Compound: Strychnine

Formula:



Alternate Names: Strychnidin-10-one

CAS #: 57-24-9

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 334.4 m.p., °C: 268-290 b.p. (5 torr), °C: 270
vapor pressure (25°C), torr: Not available
solubility in water (temp. unknown), mg/L: 156
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

Date: 6/23/80

INDUSTRIAL OCCURRENCE OF STRYCHNINE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF STRYCHNINE[a,b]

	Treated wastewater					
	Concentration, μg/L			Loading,[c] kg/d		
Industry	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR STRYCHNINE[a,b]

	Synthetic wastewater		Actual wastewater		
Treatment process[a]	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	Volume III references, Section numbers

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

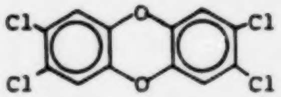
REFERENCES

1. The Chemical Rubber Company. Handbook of Chemistry and Physics, 48th Edition. Cleveland, Ohio, 1967. pp. C-546, 547.

2. Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976.

Compound: 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin

Formula:



Alternate Names: TCDD

CAS #: 1746-01-6

Physical, Chemical, and Biological Properties [1, 2]

mol. wt.: 322 m.p., °C: 303-305 b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: Not available
solubility in water (temp. unknown), mg/L: 0.0002
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: No specific data, but TCDD is extremely toxic and very resistant to all forms of degradation

photolysis: Will be an important process if reactive substrates are available
oxidation: Not an important process
hydrolysis: Does not occur
volatilization: Not important
sorption: Important process
biological processes: Bioaccumulation probably an important process
other reactions/interactions: Unknown

Carbon Adsorption Data: Not available

Date: 6/23/80

INDUSTRIAL OCCURRENCE OF 2,3,7,8-TETRACHLORODIBENZO-*p*-DIOXIN[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF 2,3,7,8-TETRACHLORODIBENZO-ρ-DIOXIN[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR 2,3,7,8-TETRACHLORODIBENZO- -DIOXIN[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., μg/L	Removal range,[c] %	Average achievable conc., μg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

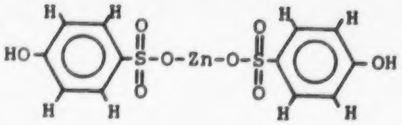
REFERENCES

1. Versar, Inc. Water-Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Washington, D.C., 1979. pp. 34-1 - 34-9.

2. Fairchild, E. J., R. J. Lewis, Sr., and R. L. Tatken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. p. 358.

Compound: Zinc phenol sulfonate

Formula:



Alternate Names: Zinc salt of 4-Hydroxybenzenesulfonic acid

CAS #: 127-82-2

Physical, Chemical, and Biological Properties [1]

mol. wt.: 411.7 m.p., °C: Not available b.p. (760 torr), °C: Not available
vapor pressure (25°C), torr: Not available
solubility in water (temp. unknown), mg/L: 625,000
log octanol/water partition coefficient: Not available
Henry's law constant: Not available
biodegradability: Not available

Probable Fate: Not available

photolysis:
oxidation:
hydrolysis:
volatilization:
sorption:
biological processes:
other reactions/interactions:

Carbon Adsorption Data: Not available

Date: 6/23/80

INDUSTRIAL OCCURRENCE OF ZINC PHENOL SULFONATE[a,b]

Industry	Raw wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

INDUSTRIAL OCCURRENCE OF ZINC PHENOL SULFONATE[a,b]

Industry	Treated wastewater					
	Concentration, µg/L			Loading,[c] kg/d		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean

---

[a] Information contained in this table was obtained from Volume II of the Treatability Manual.

[b] NA - not available; ND - not detected; BDL - below detection limit.

[c] Pollutant loadings determined by multiplying mean pollutant concentration by industry wastewater discharges as reported in Section I.3; where mean is not available, one-half the reported maximum was utilized.

Note: No data available. Data will be supplied in future revisions.

POLLUTANT REMOVABILITY/TREATABILITY WASTEWATER TREATMENT ALTERNATIVE FOR ZINC PHENOL SULFONATE[a,b]

Treatment process[a]	Synthetic wastewater		Actual wastewater		Volume III references, Section numbers
	Removal range,[c] %	Average achievable conc., µg/L	Removal range,[c] %	Average achievable conc., µg/L	

---

[a] See Volume III for detailed information.

[b] NA - Not available, ND - not detected, BDL - below detection limit.

[c] Average and maximum removals reported.

Note: No data available. Data will be supplied in future revisions.

REFERENCES

1. Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976. p. 1309.

☆U.S. GOVERNMENT PRINTING OFFICE: 1980-325-154/6389